August 5, 1957 50 Cents

# AVIATION WEEK

A McGRAW-HILL PUBLICATION

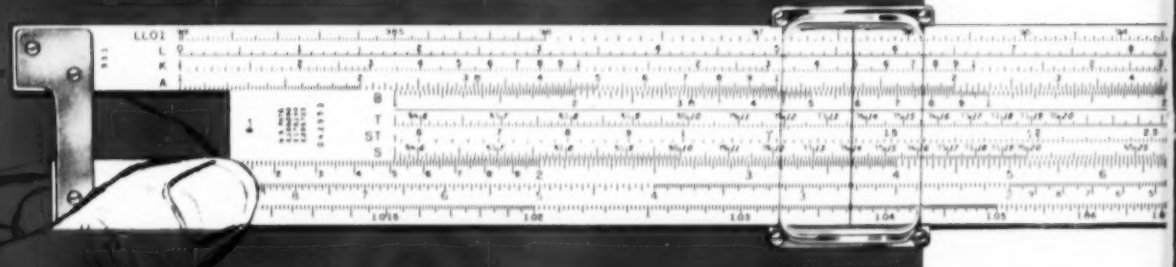
## Aircraft Industry Faces Job Decline

•

## Flying Atar VTOL Simple, Promising

Republic F-105 Thunderchief

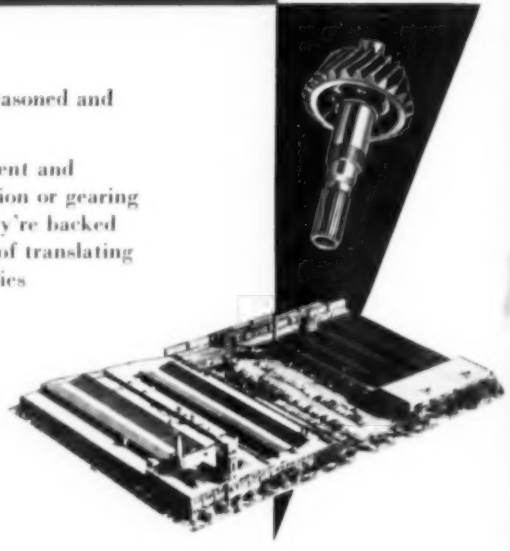
# LOOKING FOR ENGINEERS?



Can you use the experience, knowledge, and skill of our seasoned and successful engineers *right now?*

They are available immediately to solve design, development and production problems involving power transmission, actuation or gearing for any and every phase of the aviation industry. And they're backed by a modern precision production plant—a plant capable of translating advanced concepts into precision components and assemblies on a *production* basis.

You can count on Foote Bros. engineering and facilities to come through with the answer and the *production* wherever and whenever you need it. It will pay you to ask Foote Bros. first.



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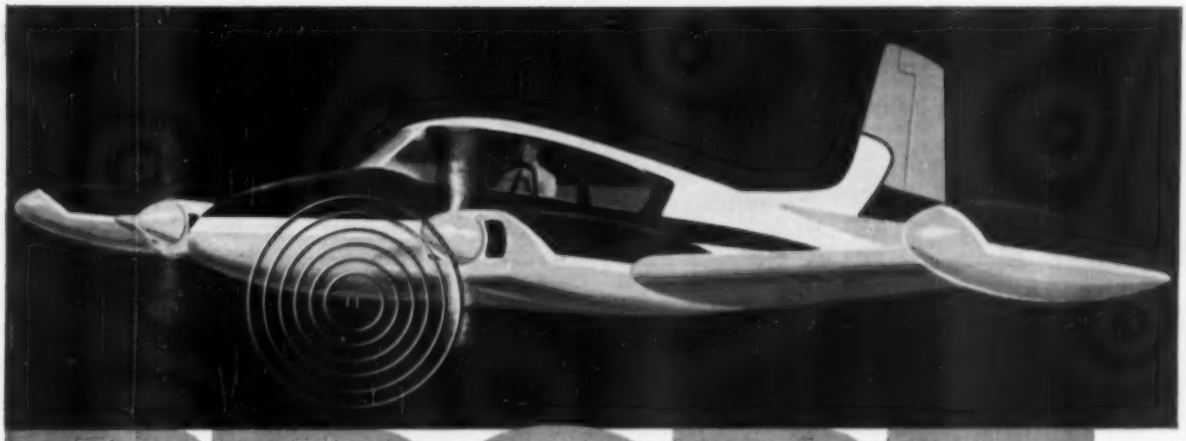

# PROBE

## that keeps **pilots out of trouble!**

### NEW AUTOMATIC ICE DETECTOR FOR SMALL AIRCRAFT

UNLIKE commercial airliners, many private and corporate aircraft—while subject to icing dangers—normally operate under conditions which do not warrant the expense of deicing equipment.

Now a new, fully automatic device, *weighing only 1.6 lbs. and easily installed,* takes these pilots off the spot giving them immediate warning of any icing danger even before it can be spotted by the naked eye!

Proved in Arctic Circle operation, USAF qualified, and already designated by Lockheed for their new Electra, the Ice Detector consists of a small, exposed "sensing probe" and an electromechanical unit which automatically warns pilots the instant icing conditions are present. Or the Ice Detector may be used to activate the deicing system of an aircraft, making it fully automatic.

A pioneer development of Canadian Applied Research Ltd., of Toronto, Canada—long-time partner of Goodyear in the development of the electrothermal Iceguard—the Automatic Ice Detector is now available to operators of American aircraft through the Aviation Products Division of Goodyear.

For complete information, write: Goodyear, Aviation Products Division, Akron 16, Ohio.

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Iceguard—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

*the world's largest manufacturing facility for aircraft seating ... for aircraft interior equipment*

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For like yesterday and today the pilot will see tomorrow's new horizon from a Weber seat.

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*pilot seat:* 7 *crew seat:* 18

## AVIATION CALENDAR

**Aug. 5-10**—National Naval Aviation Meeting, Institute of Aeronautical Sciences, U. S. Grant Hotel, San Diego, Cal.

**Aug. 6**—Helicopter Transportation in Europe Today and Tomorrow, J. Naome, Sabena Belgian Airlines, Hampton Roads Section Meeting, American Helicopter Society, Langley AFB Officers Club, Va.

**Aug. 10-11**—Midget Airplane Races, Oshkosh, Wis.

**Aug. 17**—Open house for pilots and public, Piper Aircraft Corp., Lock Haven, Pa.

**Aug. 20-22**—Bendix-Scintilla International Ignition Conference, Sidney, N. Y.

**Aug. 20-23**—Western Electronic Show & Convention, Cow Palace, San Francisco, Calif.

**Aug. 26-28**—Gas Dynamics Symposium Transport Properties in Gases at High Temperatures and Pressures, Technological Institute, Northwestern University, Evanston, Ill.

**Aug. 28-30**—Pacific General Meeting, American Institute of Electric Engineers, Pasco, Wash.

**Aug. 31-Sept. 1**—Midget Airplane Races, Ft. Wayne, Ind.

**Sept. 1-15**—Sixth International Aeronautical Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, Folkstone and London, England.

**Sept. 2-8**—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

**Sept. 3-14**—11th General Assembly, International Union of Geodesy and Geophysics, in conjunction with International Geophysical Year, University of Toronto, Canada.

**Sept. 7**—Second Annual Convention of the OX-5 Club, Hotel Phillips, Kansas City, Mo.

**Sept. 8-13**—Second Annual Course on Investment Castings, Massachusetts Institute of Technology, Cambridge, Mass.

**Sept. 9-13**—Annual General Meeting, Inter-

(*Continued on page 6*)

**AVIATION WEEK • AUGUST 5, 1957**

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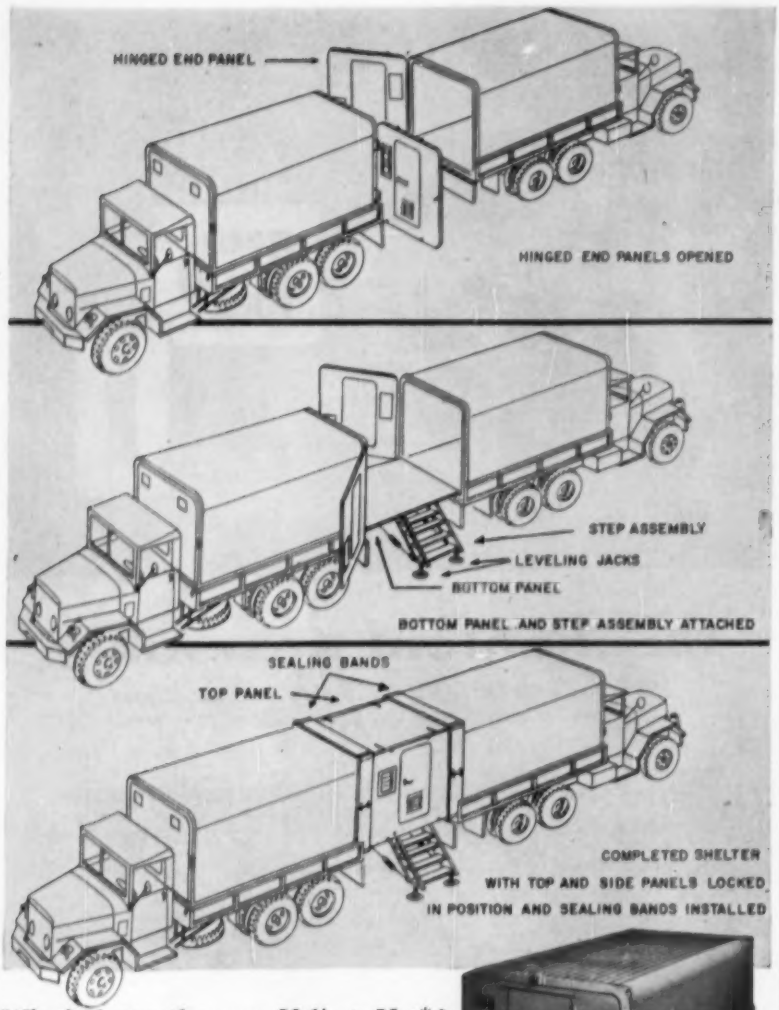


*What's better than one Helicop-Hut*?*
**ANSWER:** *Two Helicop-Huts, joined into one 32′ shelter.*

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## HERE'S WHAT THIS NEW CONCEPT OF MOBILITY MEANS TO YOU.

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## AVIATION CALENDAR

(*Continued from page 5*)

land Auditorium, Cleveland, Ohio.

**Sept. 13**—Third Pacific Area National Meeting, American Society for Testing Materials, Sheraton-Palace Hotel, San Francisco, Calif.

**Sept. 15**—1957 Garden Party and Flying Display, Royal Aeronautical Society, Wisley Aerodrome, Weybridge, England.

**Sept. 23-25**—Fall Meeting, American Society of Mechanical Engineers, Statler Hotel, Hartford, Conn.

**Sept. 26-27**—Fifth Michigan Aeronautics Conference, jointly sponsored by University of Michigan Transportation Institute, Western Michigan University, and The Aero Club of Michigan, Alpena, Mich.

**Sept. 28-29**—North Central Regional Conference, Civil Air Patrol, Town House Hotel, Kansas City, Kans.

**Sept. 30-Oct. 5**—National Aeronautic Meeting, Aircraft Production Forum & Aircraft Engineering Display, Society of Automotive Engineers, Hotel Ambassador, Los Angeles.

**Oct. 2-4**—Tenth Annual Meeting and Forum, National Business Aircraft Assn., Cosmopolitan Hotel, Denver, Colo.

**Oct. 7-9**—13th Annual National Electronics Conference, Chicago, Ill.

**Oct. 7-10**—Triennial Inspection, Lewis Flight Propulsion Laboratory, Cleveland.

**Oct. 7-12**—Eighth Annual Congress, International Astronautical Federation, Barcelona, Spain. For details write: IAF, 35 Lowell Rd., Concord, Mass.

**Oct. 9-11**—National Fall Convention, Society for Experimental Stress Analysis, El Cortes Hotel, San Diego, Calif.

**Oct. 10-11**—National Noise Abatement Symposium, Sherman Hotel, Chicago, Ill.

**Oct. 21-22**—Canadian Aeronautical Institute-Institute of the Aeronautical Sciences Meeting, Montreal, Canada.

**Oct. 21-23**—Conference on new developments in the field of power, American Society of Mechanical Engineers, Americus Hotel, Allentown, Pa.

**Oct. 24-25**—Fourteenth Annual Display, Aircraft Electrical Equipment, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

**Oct. 28-31**—Second Winter Meeting, American Nuclear Society, Henry Hudson Hotel, N. Y.

**Oct. 28-29**—Third Annual Meeting, Association of the U. S. Army, Sheraton-Park Hotel, Washington, D. C.

**Oct. 28-30**—Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md.

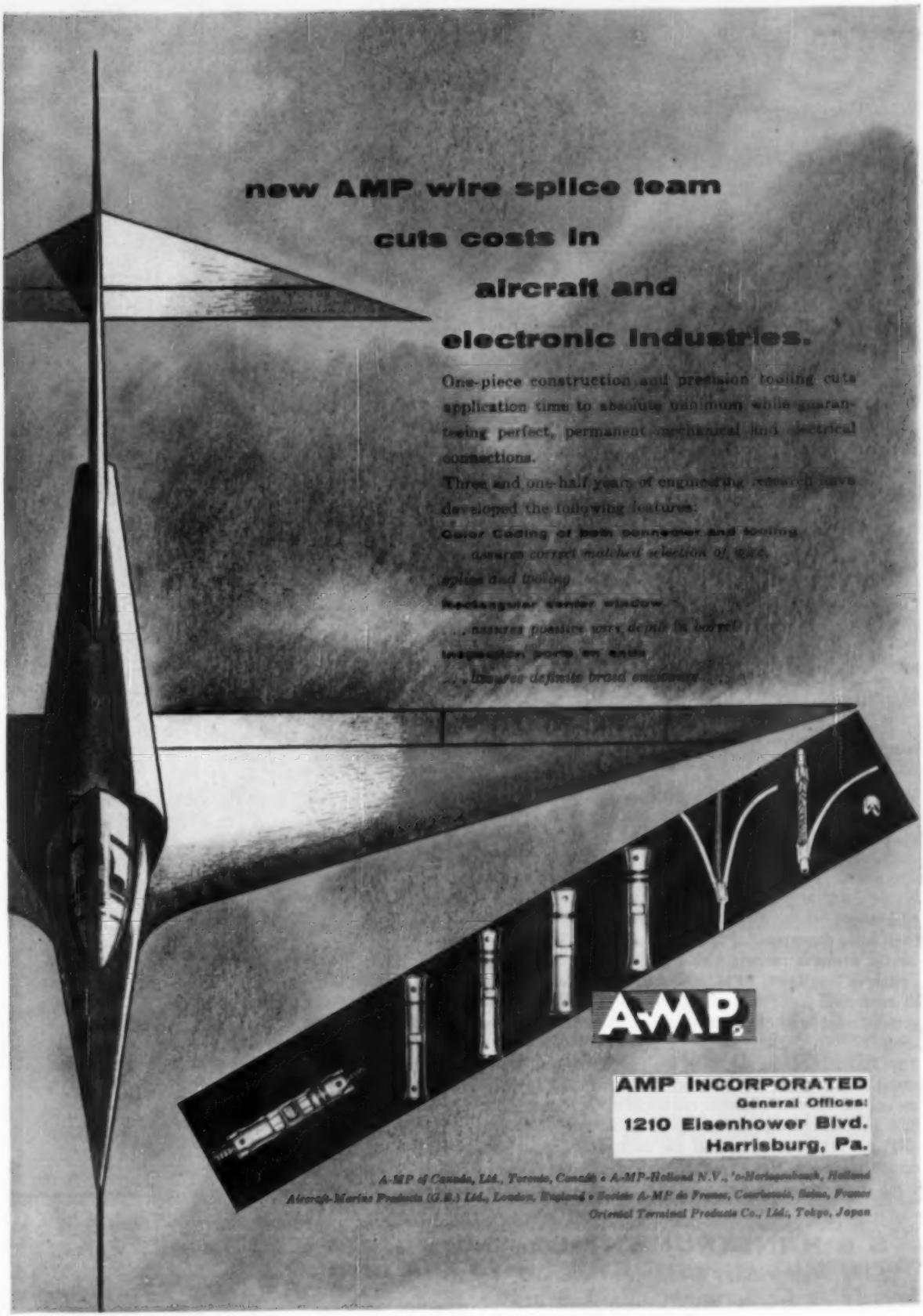
**Oct. 28-31**—National Industrial Packaging & Handling Exposition, Atlantic City, Convention Hall, N. J.

**Oct. 30**—Aviation Electrical Equipment Display, U. S. Grant Hotel, San Diego.

**Nov. 5-7**—Joint Military-Industry Guided Missile Reliability Symposium (limited to those with Secret security clearance), Naval Air Missile Test Center, Pt. Mugu.

**Nov. 6-8**—Third Annual Symposium on Aeronautical Communications, Hotel Utica, Utica, N. Y.

**Nov. 18-29**—International Air Transport Assn., Technical Conference, Miami, Fla.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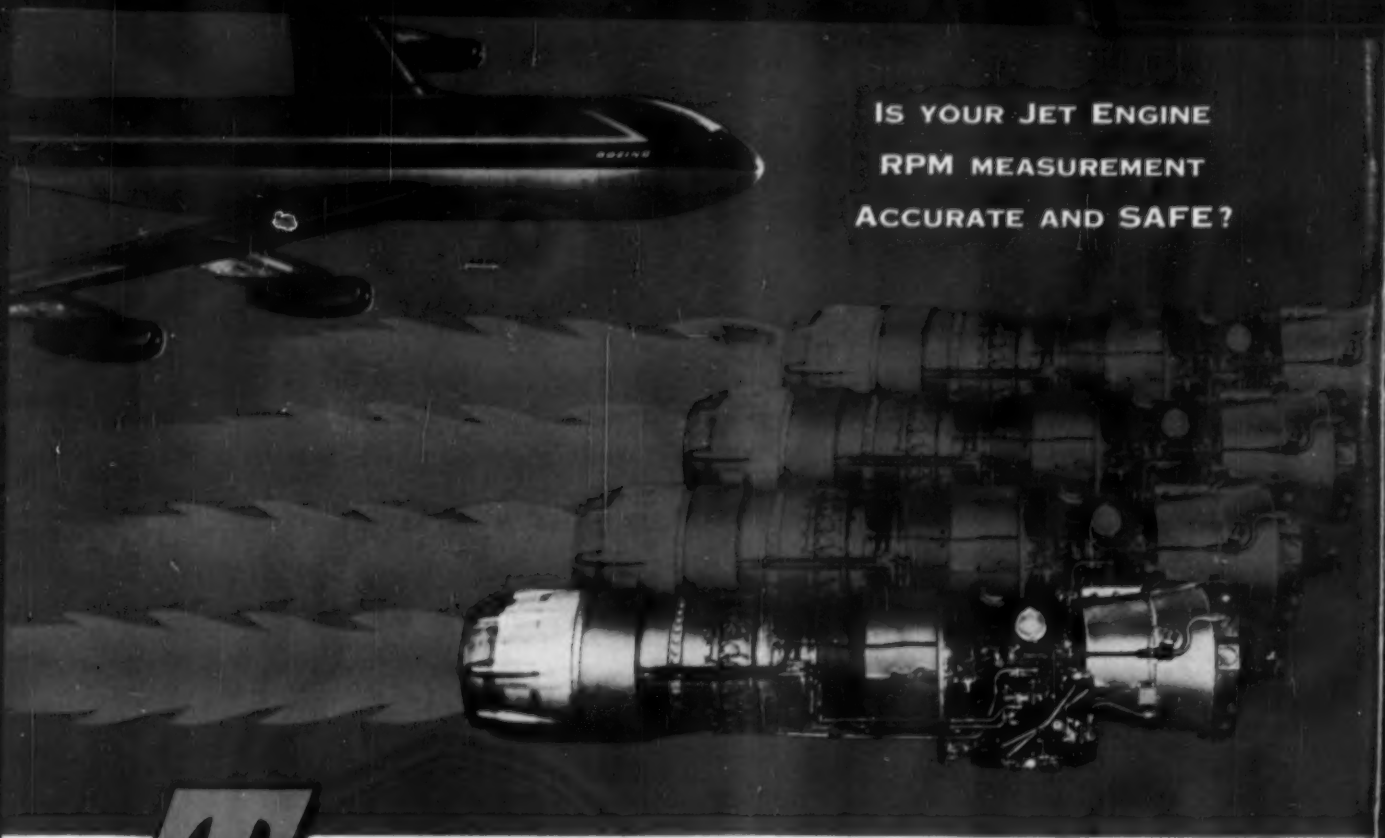

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The TAKCAL's component parts are identical with those used in the J-Model JETCAL Analyzer. They are here assembled as a separate unit tester and for use with all earlier models of the JETCAL Tester.

The TAKCAL operates accurately in all ambient temperatures from –40°F. to 140°F. Low in cost for an instrument of such extreme accuracy, it is adaptable to application in many other fields.

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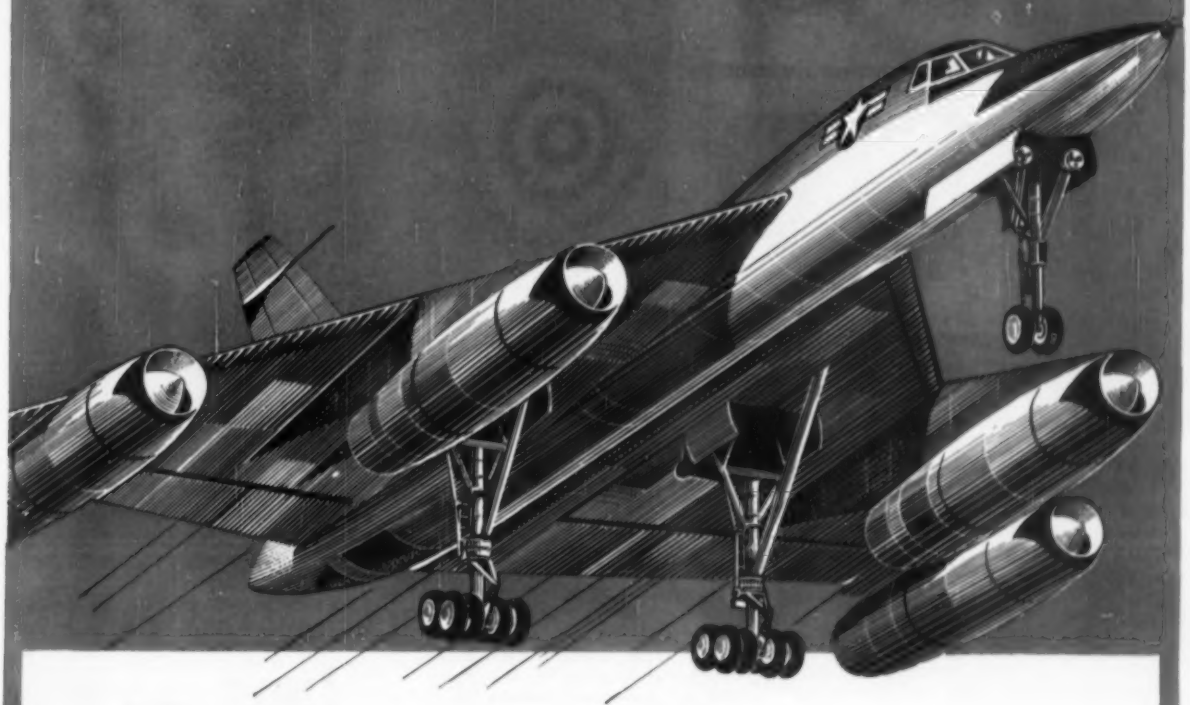
*...Because* MENASCO DESIGNS AND PRODUCES

"THE SHAPE OF THINGS TO COME" TODAY...

*in landing gear for supersonic bombers*



CONVAIR USAF B-58 *"Hustler,"* spectacular in appearance and performance, is the world's fastest bomber. Faster-than-sound, it operates at altitudes above 50,000 feet and has tremendous capabilities for the fast-changing air power concepts.

One of the important, complex major sub-systems incorporated in this great bomber is the long, bogie landing gear, designed to provide ground clearance for the external pod which carries the *Hustler's* "Sunday Punch."

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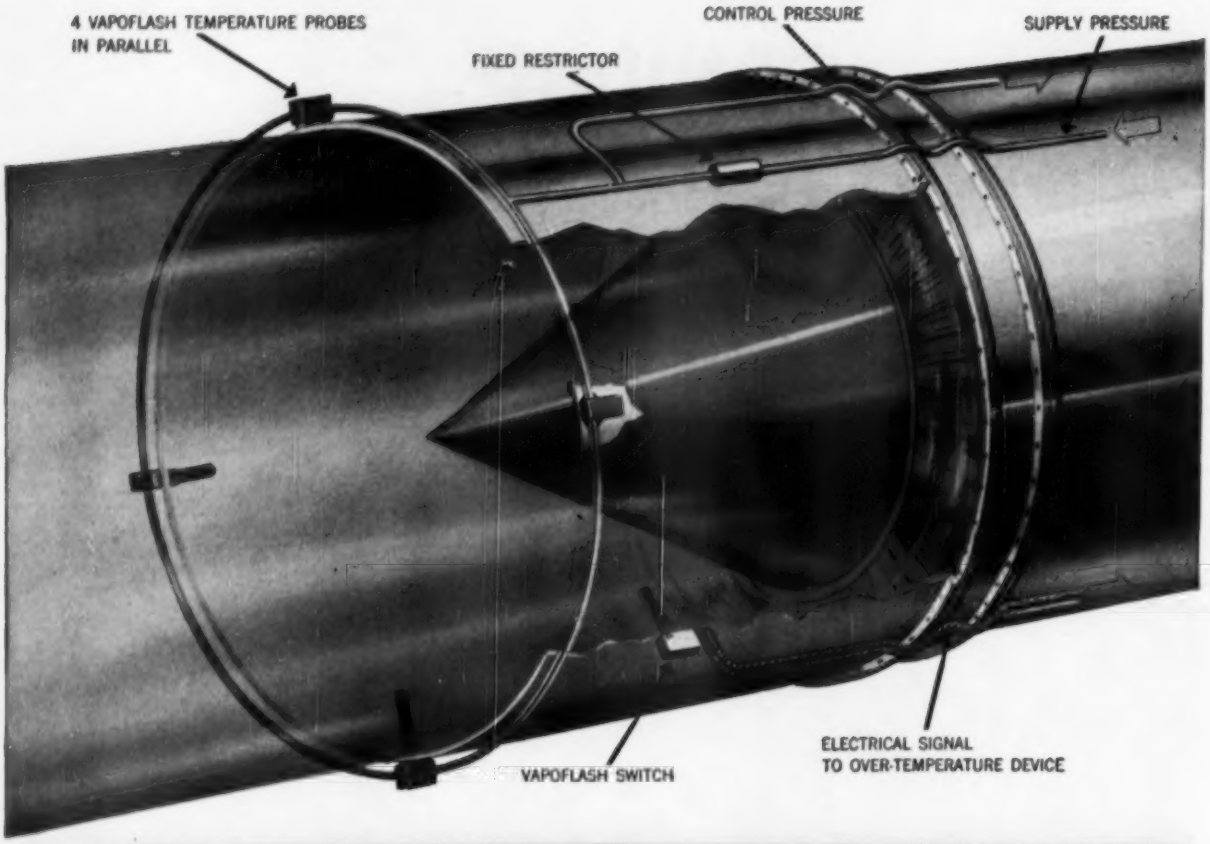


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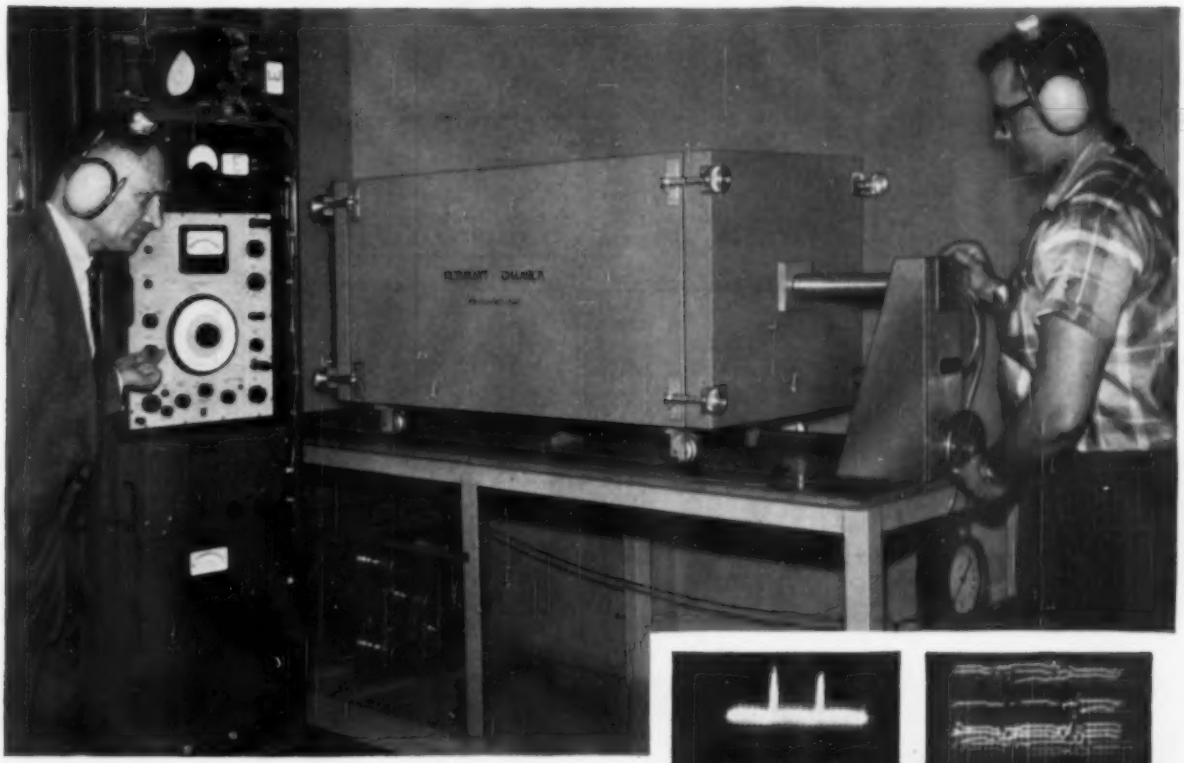
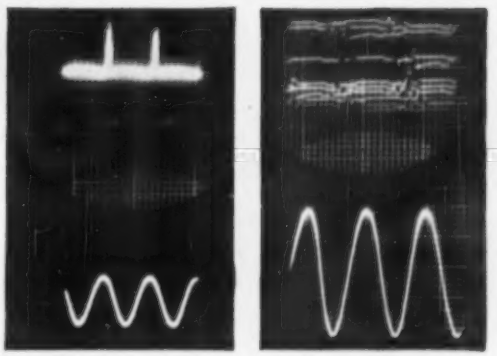


L to R: Dr. Fricke, Engineer-in-charge Acoustics Laboratory, and Mr. Kuzara Acoustics Engineer, evaluating a component in a high intensity acoustic environment. RIGHT: Malfunction of a relay at high-intensity sound as disclosed in a sound chamber.



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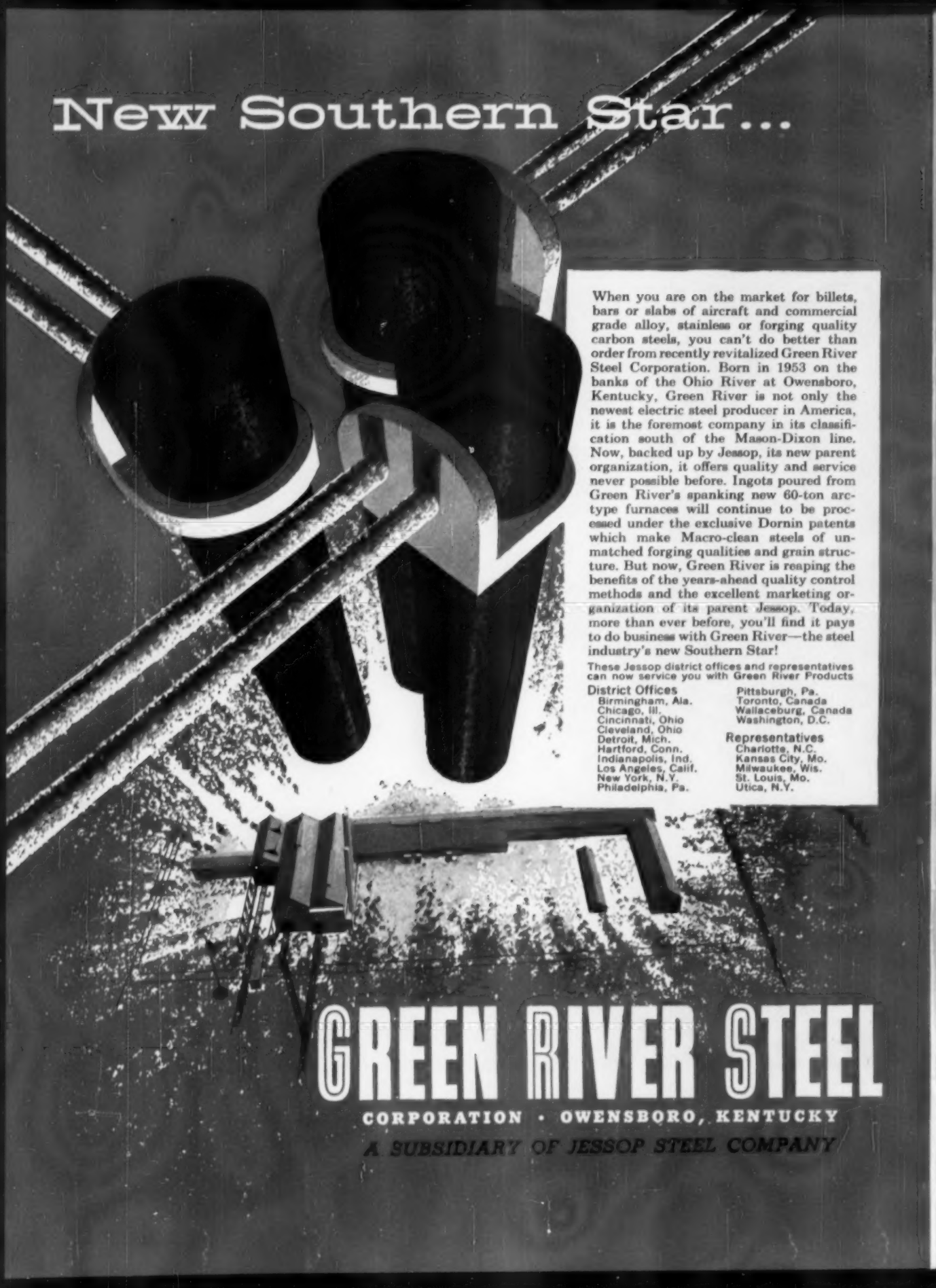
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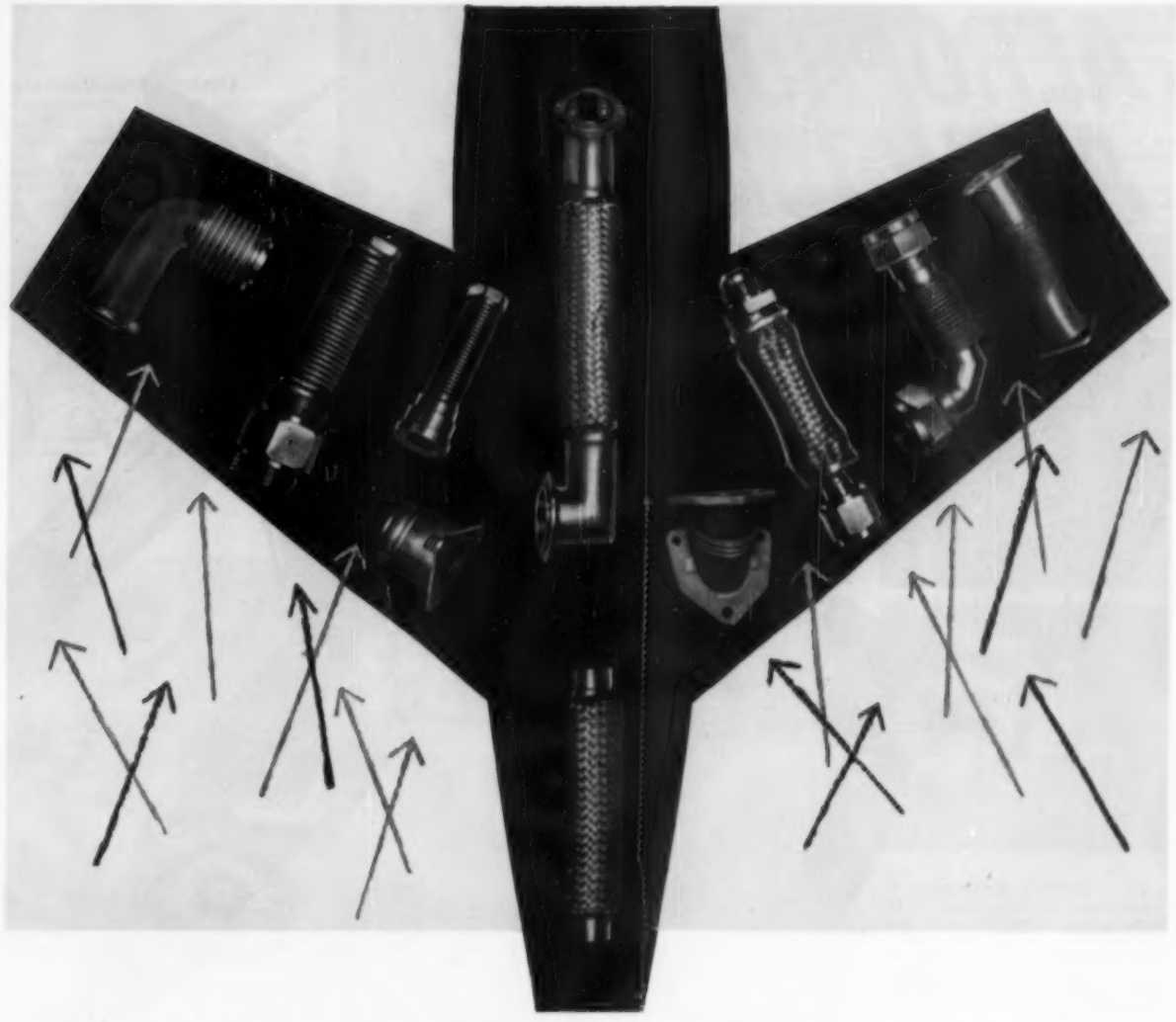

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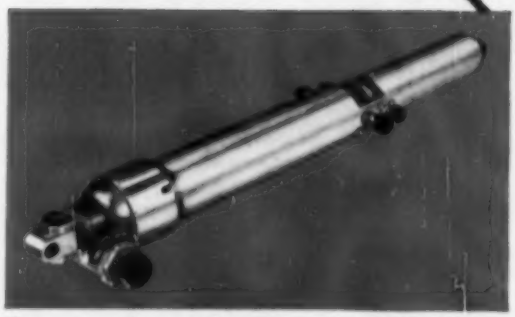

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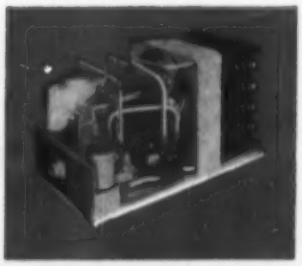

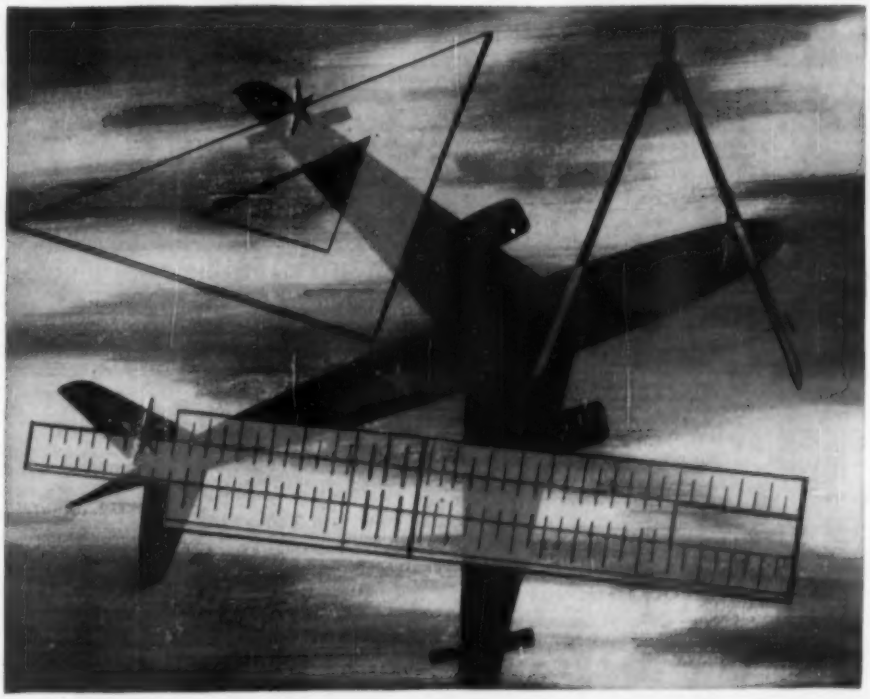

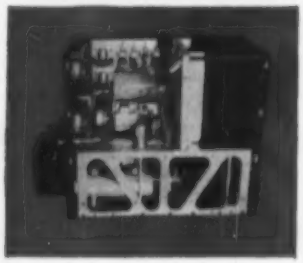

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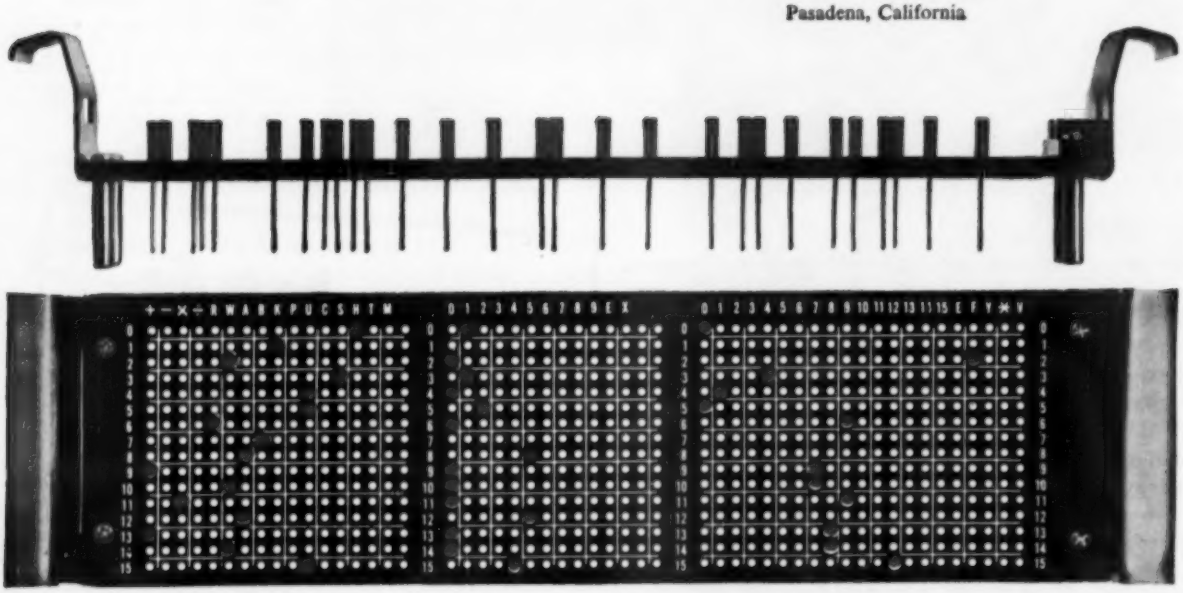

August 5, 1957

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▶ Aviation Week survey indicates spending slowdown to eliminate at least 40,000 jobs by year's end.

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▶ Bitter issue appears to be headed for settlement; military withholds comment pending further study.

**Flying Atar VTOL Is Simple, Promising..... 50**
▶ French vehicle, which uses thrust deflection, bleed jets for control, made strong impression at air show.

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**COVER:** Photographed from below, Republic's F-105 Thunderchief presents a pictorial plan view of its area ruled fuselage, unusual wedge shaped inlets, and thin swept back wings with rounded tips. Details of aircraft's inlet, speed brakes are on pages 30 and 31 and over-all views with weapons load are on pages 74 and 75.

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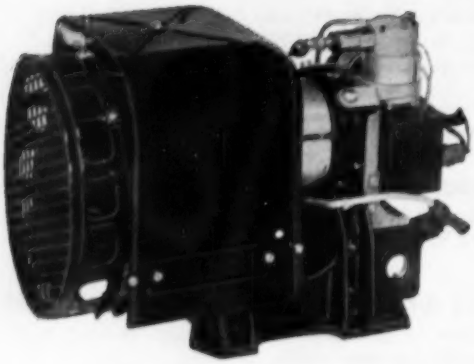

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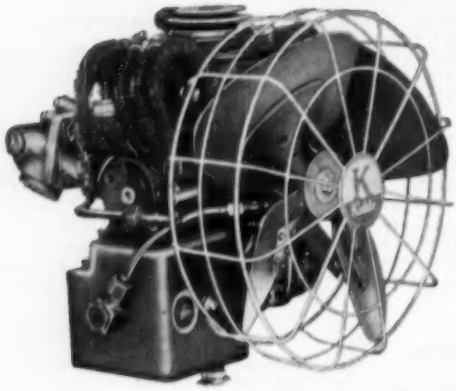
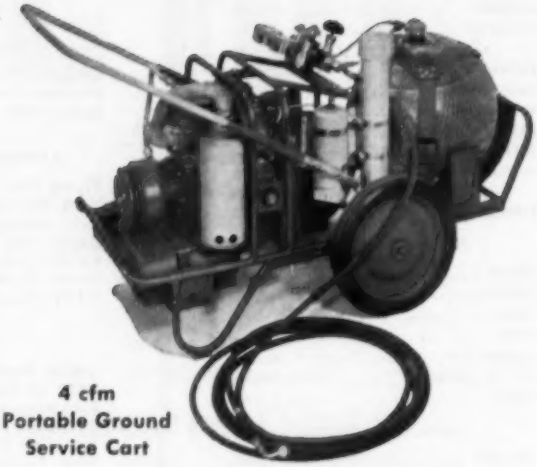


6 and 8 cfm Compressors



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# EDITORIAL

## A Pattern Emerges

Some distinct outlines of the future military airpower program resulting from the frenzied fiscal juggling and organized confusion of the Fiscal 1958 Defense Appropriations Bill emerged last week in the red brick hilltop hotel in Washington where the Air Force Association held its annual convention. An imposing array of top USAF military and civilian brass plus two of the most influential Senators on defense matters—Leverett Saltonstall, Republican of Massachusetts and Stuart Symington, Democrat of Missouri, did a remarkably frank job of spelling out in as much detail as it is possible to glean from the current confusion just where we are heading in our military airpower program.

The picture they painted is not rosy.

Even Sen. Saltonstall, who has been the Eisenhower Administration's staunchest supporter on defense policy on Capitol Hill, is "disappointed" with the airpower aspects of the Fiscal 1958 Defense Appropriations Bill. Sen. Saltonstall also warned that any superiority over Soviet airpower we may now enjoy will last only for another 18 months and urged a "reappraisal" of our airpower picture in 1958.

Sen. Symington of course went further in his critique of current policy. He bluntly charged that defense policy was now being determined solely from the budgetary viewpoint, without any real regard for the strength of our military forces versus those of the Communist bloc. He further charged that the incredible fluctuations of the military airpower program during the past year are wasting billions of tax dollars without achieving any improved military strength. He cited data furnished him by the Pentagon showing that there had been 17 major budget changes in the Air Force program during the past year. The wasted dollars resulting from these incessant changes would be ample to finance adequate airpower, he said.

### Deliberate Deception

Sen. Symington also hit hard at a matter that has the aircraft industry deeply troubled. He charged that information released by the Defense Department on the new airpower program was deliberately deceptive and as a result would lead to serious economic dislocations in areas where layoffs were inevitable because of production stretchouts and program cancellations. Industry has had a tough time getting any solid data pried loose from the Pentagon on the manpower problems facing individual firms in specific communities as a result of the program changes. These firms have an acute public relations problem in their specific communities regarding employment changes. It would be wise for the Pentagon to recognize this fact before irreparable harm is done to the reputation of the aviation industry in key areas with the special skills required for this type of work.

As an example of the gobbledeygook now being peddled by Defense Department officials to mask the real scope of their cutbacks, Sen. Symington cited his interrogation of Deputy Defense Secretary Donald Quarles, who was then USAF Secretary, on the cancellation of the Douglas C-132 transport program after some $93 million had been spent on development to the mock-up stage. Secretary Quarles told Symington the reason for the cancellation was that USAF was concentrating on the Douglas C-133, a smaller transport now flying in prototype stage. The Senator asked the Secretary how many C-133s USAF planned to purchase with Fiscal 1958 funds. The Secretary professed ignorance on this subject, conferred with his aides and then informed Sen. Symington that no C-133s would be purchased in the Fiscal 1958 program. Asked Senator Symington, "What kind of concentration is this?"

### Douglas Warns Industry

USAF Secretary James H. Douglas did his usual blunt, frank job of explaining an inexplicable situation as well as possible. "There are still many areas where no final decisions have been made," he told the convention. This means of course that industry will have to follow the meanderings of Pentagon policy extremely closely in the months ahead if it is not to be caught unaware by major policy shifts. Secretary Douglas was more frank than any Defense Department official to date in detailing the programs that have been stretched or cut, and the timing thereof. He also warned that USAF must cut its Fiscal 1958 expenditure estimates by a billion dollars because of administration imposed budget limitations.

He also warned that development programs are getting a thorough screening by USAF and the less promising avenues of development will certainly be abandoned during the next few months. A more realistic appraisal of modification programs on the basis of shooting only for major technical improvements also is in prospect.

To put the picture in its proper perspective Secretary Douglas emphasized that Fiscal 1957 which just ended had the highest peacetime expenditure in history ($7.5 billion for hardware) and that Fiscal 1958 would have the second highest, with some $7 billion for procurement of aircraft, missiles and related equipment.

Gen. Edwin Rawlings, whose long tenure as Air Materiel Commander qualifies him as the best military manager in the business, offered some interesting blueprints for the transition period of the next decade, when piloted aircraft and missiles will exist side by side in the airpower arsenal. Most significant perhaps was his warning that missiles will have to force their way into the USAF weapons inventory on the basis of performance superior to any other type of system for a particular combat mission. There has been too much technically uninformed talk about how missiles would supersede manned aircraft for virtually all missions in the immediate future. Spreaders of this doctrine would do well to heed the realistic appraisals of Gen. Rawlings and Lieut. Gen. C. S. Irvine, Deputy Chief of Staff for Materiel, who also spoke to the industry gathering.

This type of a broad aviation industry-USAF meeting is a valuable supplement to the sales pitch and bargaining sessions of individual firms doing their business in the Pentagon. The USAF-industry relationship can thrive only in this atmosphere of free interchange of information that offers both sides an opportunity to understand better the others' problems and goals. —Robert Hotz

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**Malcolm E. McAlpin**, a director, Hiller Helicopters, Palo Alto, Calif.

**Clayton Triggs**, president, and **Jerry Parks**, chief engineer, Microdot, Inc., South Pasadena, Calif. Messrs. Triggs and Parks succeed **Gordon P. Felts**, retiring, who was president and chief engineer.

**Louis R. Ripley**, president, Waltham Precision Instrument Co., Waltham, Mass.

**Richard A. Powley**, president, Pesco Products Division, Borg-Warner Corp., Bedford, Ohio.

**James F. Connaughton**, executive vice president, and **Harold M. Miller**, senior vice president, Wheelabrator Corp., Mishawaka, Ind.

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**Robert J. Lang**, a vice president, Aircraft Engineering & Maintenance Co., Oakland, Calif.

**Frank LaHaye**, vice president-sales, McCormick Self Associates, Hollister, Calif. Also: **Ernest J. Stecker**, assistant to the president and acting chief engineer.

**Sam Gurley, Jr.**, vice president-sales, Olin Aluminum, Olin Mathieson Chemical Corp., New York, N. Y.

**Dr. C. B. Jolliffe**, vice president and technical director, RCA Defense Electronic Products, Radio Corporation of America, Camden, N. J. Also: **Joseph M. Hertzberg**, manager, Defense Marketing. **William B. Kirkpatrick** succeeds Mr. Hertzberg as manager, Airborne Systems Department.

**Col. Albert A. Arnhym**, Special Assistant to the Commander, Gen. Thomas S. Power, Strategic Air Command, Omaha, Neb. **Lt. Col. Carlo Tosti** replaces Col. Arnhym as Director of Information Services, Air Research and Development Command, Baltimore, Md.

**Harold G. Hynd**, general manager, El Segundo Division, Douglas Aircraft Company, Inc., Santa Monica, Calif. **Jess L. Jones** succeeds Mr. Hynd as vice president-general manager, Douglas' Tulsa Division.

**Gladyn H. Putt**, executive assistant to the vice president and general manager, Missile Systems Division, Lockheed Aircraft Corp., Sunnyvale, Calif.

**Vice Adm. Joseph F. Bolger** (USN, ret.), director of Washington, D. C. offices, Grumman Aircraft Engineering Corp., Bethpage, N. Y.

**Edward Margolin**, Assistant to Under Secretary of Commerce for Transportation, U. S. Department of Commerce, Washington, D. C.

## Honors and Elections

**Robert C. Geffs**, manager of the Contract Division of Clary Corp., has received a citation from the American Ordnance Association in national recognition for his role in the country's defense and preparedness.

# INDUSTRY OBSERVER

► Thirteen companies are participating in Navy competition for new carrier based attack bomber. Specifications call for more equipment, increased range and firepower. Design accepted probably will fill gap between A4D's gross weight of about 15,000 lb. and A3D's 70,000 lb.

**► USAF is considering abandonment of plans to have Ford Aircraft Engine Division at Chicago produce the Pratt & Whitney designed J75 turbojet as a second source. Ford still has a production backlog of about 3,000 P&W-designed J57s at its Chicago plant. All J75 production probably will be done in Pratt & Whitney's Connecticut plant.**

► Later configurations of the Republic F-105 Thunderchief, including two-seat trainer and all-weather versions, will carry advanced models of the Pratt & Whitney J75 engine. Among version to be used in trainer and all-weather models will be J75-P-10. F-105A carried J57, F-105B carries J75-P-3 but will be refitted with J75-P-5.

**► First Chance Vought Regulus II missile powered by a General Electric J79 engine is expected to fly in about two months. Current version uses the Curtiss-Wright J65. Regulus II is averaging more than three flights per missile in Navy's test program.**

► Vertical takeoff project for USAF is in design stage at Republic Aviation Corp. It would take off in horizontal attitude like Bell X-14. Both single and multiple powerplant configurations are under study. Republic considers General Electric J85 the most promising engine for it.

**► Lockheed Missile Systems Division is considering use of SOFAR bomb, triggered by hydrostatic fuze, in nose cones of Navy's Polaris IRBM test vehicles in order to pinpoint underwater location of nose by cross-triangulation of explosion following sea-range firing.**

► Snd Aviation's Trident rocket powered interceptor will appear shortly in third basic version, using Turbomeca Gabizo engines with afterburners at the wingtips. Trident will have increased fuel and strengthened landing gear to comply with NATO requirement for landings on unprepared fields.

**► Grumman Aircraft Engineering Corp. has begun cutting metal on its new twin turboprop Design 159 executive transport and is confident of meeting schedule for first flight next May (AW July 8, p. 26). Three production airframes will be built while first two prototypes are undergoing Civil Aeronautics Administration Certification under Part O4b. Grumman believes CAA certification should come in 7-11 months after first flight.**

► One version of the Chance Vought F8U-3 fighter under development for the Navy is powered by a large RMI rocket motor in addition to a J75 turbojet. Speed of this configuration is well above Mach 2 which was previously announced for the aircraft.

**► Annular wing VTOL configuration developed by Fletch-Aire, Inc., of Newton, N. J., will be submitted to Office of Naval Research for study. Army already has seen basic configuration. After vertical takeoff, wing and ducted contrarotating propellers can be mechanically pivoted around cockpit pod. Control is achieved by conventional stick and rudder pedals. Symmetrically mounted rudder and ailerons are located at end of shrouded fins. With two General Electric T58s and at 6,000-lb. gross weight, top speed is estimated at 187 knots.**

► Army is considering continuation of the Fairchild deflected slipstream test bed project with turbine engines to replace the four piston engines in the original design. Design would be applied to Army's requirement for STOL transport aircraft.

**► Vertol Aircraft Corp. expects that its H-21D helicopter, powered by two General Electric T58 engines, will make its first flight next week. Vertol's tilt-wing test bed for the Army VTOL competition also is almost ready for first flight.**

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# Washington Roundup

## Hebert Engine Investigation

Future course of hearings on the profits and procurement policies of aircraft engine manufacturers before the House Armed Services Investigating Subcommittee appears to hinge mainly on how long the House remains in session.

Subcommittee hearings were canceled "indefinitely" last week by Chairman Edward Hebert (D.-La.) because the full Armed Services Committee was meeting. Pratt & Whitney Aircraft Division of United Aircraft Corp., Westinghouse Electric Corp. and General Electric Co. were scheduled to appear. The subcommittee has only heard one manufacturer so far: Curtiss-Wright Corp. (AW July 29, p. 38).

Hebert didn't rule out the possibility that the investigation might be dropped until next year.

## The Senator From USAF?

Misstatement of the week was made by austere Bostonian Sen. Leverett Saltonstall before the Air Force Association convention. Referring to Sen. Stuart Symington, who shared the platform with him, he said: "And I am sure Sen. Twining will agree with me." Then he paused and said, "I don't know why it is, but I always refer to him as Sen. Twining." Gen. Nathan F. Twining former USAF Chief of Staff and now Chairman of the Joint Chiefs, was not present.

Saltonstall, senior Republican on the Armed Services Committee, was agreeing with Symington that the new Air Force budget is a disappointment. At the same time, he insisted that USAF is big and strong enough to meet its obligation at this time. He recommended that its strength be reappraised in a year or a year and a half. Saltonstall disagreed with both Symington and the AFA on their assertion that Russia is superior to the United States in the ballistic missile field.

## Civil Aviation Bills

Delayed in Washington by the Senate's civil rights debate, Congress took action last week on several civil aviation measures:

• **Airways Modernization Board.** Lt. Gen. Elwood R. Quesada, who replaced Edward P. Curtis as special assistant to the President for aviation, is expected to be named shortly to head this new agency to develop an airways navigation system (AW July 1, p. 30).

Legislation creating the three-member board, already passed by the Senate, was overwhelmingly approved by the House last week, 375 to 17. Other members would be the Secretary of Defense and the Secretary of Commerce (AW Apr. 15, p. 29). A technical House amendment, limiting the President's authority to transfer funds from other agencies to the new Board, could necessitate a special appropriation.

• **Local service measures.** Legislation which would permit subsidized carriers to set aside earnings from equipment sales for the purchase of new equipment, primarily aimed at aiding local lines with their re-equipment programs, was approved by House Commerce Committee, but enactment this year is unlikely. The measure was passed last year by the Senate and approved by the House committee, but was killed on the House floor.

Another measure aimed at assisting the local lines with equipment financing was approved by the House Judiciary Committee. This gives lending institutions rights to equipment they have financed in case of bankruptcy.

• **New Washington Airport.** A $35 million appropriation for an alternative airport at Burke, Va., to serve the capital again—as it has for the past seven years—faces unyielding opposition of the Maryland delegation. They want Baltimore's Friendship Airport used. In his request, the President was insistent: "The responsible executive agencies have concluded that the best available long-term solution is a new airport at the Burke site."

## Missile Information

USAF is making headway in its campaign to have more—and more accurate—information released on guided missile firings. USAF Secretary James H. Douglas has discussed the matter with Secretary of Defense Charles E. Wilson. USAF's Office of Information Services is expected to make a formal presentation to Wilson this week, showing that much officially "classified" information on missile firings is publicly known.

A memo issued by Murray Snyder, Assistant Secretary of Defense for Public Affairs, now prohibits the disclosure of any details except confirmation of the fact that a test firing has occurred and "a brief statement" as to any casualties. In testimony before the House Government Information Subcommittee, Brig. Gen. Arno H. Luehman, director of USAF's Office of Information Services, noted that USAF is concerned "that an erroneous impression (on misfirings) is getting widespread and is gaining somewhat the aura of truth. We feel . . . that the progress we have made in this missile development firing has reached the point now that we ought to consider telling a little more about it" (AW July 15, p. 31).

In a letter to Snyder, Rep. John E. Moss (D.-Calif.), chairman of the House Government Information Subcommittee, complained that Snyder's assurance that he wants "to get out the news" and his missile firing memo are not consistent.

Whatever loosening of missile firing information that may be approved by Wilson will then have to be approved by the Operations Coordinating Board, headed by Under Secretary of State Christian A. Herter, and composed of representatives of the President, Defense Department, Central Intelligence Agency, and U.S. Information Agency.

## Newbury Successor?

Paul D. Foote, 69, physicist, research consultant and a former executive vice president of Gulf Research and Development Co., is being mentioned as a possible successor to Frank D. Newbury, former Assistant Secretary of Defense for Research and Engineering.

Foote now is in the Pentagon as a consultant on materials for the National Academy of Sciences, but Pentagon observers say this time also is being used for a mutual sizing-up. Since Newbury left the post after controversy over his attitude toward research and development (AW Apr. 29, p. 27), administration has been unable to find anyone to fill it.

Foote also held executive positions with Gulf Oil Corp. and Gulf Refining Co. before retiring in 1954 to become a consultant.

He now lives in Washington and does a considerable amount of work for the National Academy.

—Washington staff

# Employment Drops From 900,000 Peak

**Aviation Week survey indicates spending slowdown to eliminate at least 40,000 jobs by year's end.**

Job reductions among 22 major aviation firms will exceed 40,000 by the end of the year according to current planning, an AVIATION WEEK survey indicates.

Companies emphasized, however, that the employment situation is uncertain. Sales between now and the year's end will directly affect hiring policies at most firms. Expected further reductions in defense spending will decrease jobs still further at some companies. Others say they will be hiring if hoped-for contracts are awarded.

Most firms hope to take care of reductions through what they describe as normal rate of attrition, avoiding layoffs wherever possible.

Area hardest hit is Southern California. Los Angeles metropolitan area, for instance, employs more than 200,000—approximately one fourth of all aircraft and parts workers in the nation. Shortly before defense cutbacks began to be felt, this accounted for about 29% of manufacturing employment in the Los Angeles area, and almost 9% of total employment. San Diego area employs approximately another 55,000 aircraft and missile workers.

Production workers are facing the largest cutbacks. Some firms are reducing engineering staffs, but this is partly offset by continued hiring at other plants, particularly in missile work and especially of highly-skilled engineers.

### Hiring Cutback

In addition to eliminating jobs a number of companies have slowed down hiring.

Reduction figures in this AVIATION WEEK survey do not include the secondary job reductions that will result among some subcontractors.

Point to remember in current employment decline is that industry averaged 800,000 workers in 1956 to become the nation's largest employer for a full 12-month period for the first time in history (AW Dec. 31, p. 26).

Department of Labor's Bureau of Labor Statistics listed wage and salary workers in the aircraft and parts industry at 908,600 in March of this year as compared with 772,600 in March of 1956.

The bureau's figures also show a further increase to 909,100 in April, and then a decline for May to 902,400, but the May figure is preliminary. June and July figures, which will reflect largest reductions, are not yet available.

Many aircraft companies hired through the last half of 1956 and some have continued right up to the present, but some companies reported they began to slow down hiring or to reduce staffs as early as last January.

Here is the employment outlook at some of the major aviation firms:

### North American Aviation, Inc.

North American now expects a total reduction of 12,000 by the end of the year instead of the 15,600 announced just after cancellation of the Navaho missile contract (AW July 22, p. 29). Prior to Navaho cancellation total employment was 69,197, with 49,849 of these in the Los Angeles area. Reductions in that area through Aug. 15 now are expected to total 7,300. Additional 4,700 reduction will be accomplished in next four months, some of it through attrition. Bulk will be in the Los Angeles area, from the Missile Development and Autonetics divisions. Highest reductions are in production, with engineering and technical areas next. Some lower echelon administrative jobs also are being cut.

Employment by divisions before the Navaho cancellation was: Los Angeles, 23,969; Columbus, 15,786; Fresno, 2,414; Missile Development at Downey, 7,134; Autonetics at Downey, 7,204; Rocketdyne at Canoga Park, 10,564; Atomics International at Canoga Park, 1,500; general offices, 626.

Of North American's $873,142,213 backlog on June 30, approximately $126 million represented the Navaho project. Among reasons why initial cutback figure has been lowered are continuing Navaho flight test activities, termination work, continuing component developments, shifts of Navaho personnel to other projects, further reductions in overtime in all divisions, rescheduling of some F-100 work, acceleration of certain projects and general levelling of manpower requirement curves, and receipt of a subcontract for sheet metal work from another Los Angeles aircraft manufacturer.

North American also is working on propulsion systems for Atlas, Thor, Jupiter and Redstone missiles, producing FJ-4s, developing the Navy A3J and a USAF long range interceptor, continuing studies on the WS-110A chemical bomber, building the X-15 rocket research plane and producing the Navy T2J jet trainer.

### Douglas Aircraft Corp.

Douglas employs 78,730 and expects to reduce this by 8,000 in the next six months. Attrition is expected to take care of virtually all of this. Most reductions will be in production. Next category will be administrative. Engineering personnel will increase slightly, mostly in missile work. Electrical-electronic engineering category now has greatest shortage. Employment by divisions is: Santa Monica—including Culver City plant, offsite employes in Southern California and general offices—26,422; El Segundo, including Torrance plant, 25,314; Long Beach, including Tucson plant, 17,740; Tulsa, 8,254; Charlotte, N. C., 1,000. Reduction cannot be shown by divisions, because work is often shifted between divisions, especially in California.

### Lockheed Aircraft Corp.

Lockheed employs 57,100. Reduction of 2,000 to 3,000 is estimated within the next six to 12 months to be spread between the California and Georgia divisions, but employment in Missile Systems at Van Nuys and Sunnyvale probably will increase. Primary

## Union Estimates

**Los Angeles—About 100,000 aircraft industry employes will be affected by layoffs and job reductions if a $3 billion reduction in defense spending is carried out, according to A. C. McGraw, grand lodge representative of the International Association of Machinists, Southwestern Territory.**

**McGraw said IAM feels that it and the United Auto Workers of America were caught totally unaware by defense expenditure cutbacks and should have been invited to Air Force briefings along with management. He feels government has an obligation to hold skills by stretching contracts and substituting new contracts for old ones canceled. Although most of North American Aviation Inc. workers can be absorbed, he says, they will be dispersed and many will lose their classification as skilled employes.**

**Labor's bargaining, which begins early next year with almost all major aircraft companies in this area, will be tougher. McGraw says goals will be a notice period for terminations, gradual stretchout of layoffs and severance pay.**

**McGraw also said some workers have lost 20% of their pay because of cuts in overtime and will want 20% more to make this up. United Auto Workers estimates overtime cutbacks have cost some workers $17 to $36 a week as a result of cuts in overtime and says only highly skilled workers are finding it easy to relocate after layoffs.**

reduction will be in production and administrative areas. Engineering is being increased in missiles, but emphasis is on increasing scientist personnel in missile field. About half of the 2,000-3,000 reduction will be taken care of by turnover. Employment by divisions is: California, 33,000; Georgia, 19,000; Missile Systems, 5,100.

### Convair Div. of General Dynamics

Total Convair employment is 73,000. No sudden or large layoffs are expected. Slight decline may occur at San Diego. Ft. Worth, which has reduced work force by 1,000 in the past month, expects a further reduction of about 1,000 by year's end. Convair's engineering hiring began tapering off about six months ago because requirements were pretty well filled. Slight decline in engineering force may result from continual review of job performance. Men still are being sought in aeronautical, mechanical, electrical, electronic, missile and production engineering, but with more selectivity.

Production employment decline at San Diego will be gradual and much of it will be absorbed by normal turnover in indirect labor. Indications are that some military aircraft deliveries will be deferred to the next calendar year, and some 1958 deliveries will be stretched into 1959. Ft. Worth Division, which had a Korean emergency peak employment of 31,100, now employs 26,000. This is up from 24,000 a year ago but down from 27,000 a month ago. Cut of 1,000 in next five months will be handled the way recent reduction was—some layoffs and some turnovers. Bulk of past month's reduction was in production workers, but the next 1,000 will include administrative. Engineers are still being hired but at a slower rate.

## Los Angeles' Stand

**Los Angeles—President Charles E. Ducommun of the Los Angeles Chamber of Commerce says the Chamber intends to see that the Southern California area is not discriminated against in the cutback of defense contracts.**

**Ducommun said the Chamber also intends to see that the concept is not used to cover a move to disperse the industry from that area. The Chamber recognizes that some changes in types or products and contracts of California companies are inevitable and is urging companies to diversify. He agrees that the cutbacks are aimed at greater economy, sound business practices, modernized weapons.**

**"The scientific, engineering and production know-how contained in the Southern California plants are vital to the Air Force and it is essential that they be effectively utilized for most efficient development of whatever air defense system we have in the future," Ducommun said.**

Large production contract for the B-58 could mean some change in employment picture. Employment by divisions other than Ft. Worth: San Diego, 32,339; Astronautics, San Diego, 8,395; Pomona, 5,061; Daingerfield, Tex., 371; general offices, San Diego, 310.

### Northrop Aircraft Inc.

Northrop employs 22,831 and its subsidiary Radioplane Co., 2,346. No substantial change is expected in the next six to 12 months, although engineering and technical totals may creep up at Radioplane. Hiring to meet turnover will continue. Employment by divisions: Hawthorne, 20,958, which includes 516 at Patrick AFB, 1,420 at Palmdale, 179 at Edwards AFB, 71 at Los Angeles Airport and 38 at Holloman. Anheim plant employs another 1,873.

### Boeing Airplane Co.

Boeing employs more than 80,000. Work force in Seattle-Renton area will have been reduced between 6,000 and 8,000 by the first of the year. Attrition is expected to take care of most of this. Hiring for this area has been stopped except for some highly skilled and technical categories.

Wichita Division employment will be reduced by 3,000 to 4,000 in the next six months. Boeing said "further possible reductions beyond the first of the year cannot be projected at this time because of the variables involved."

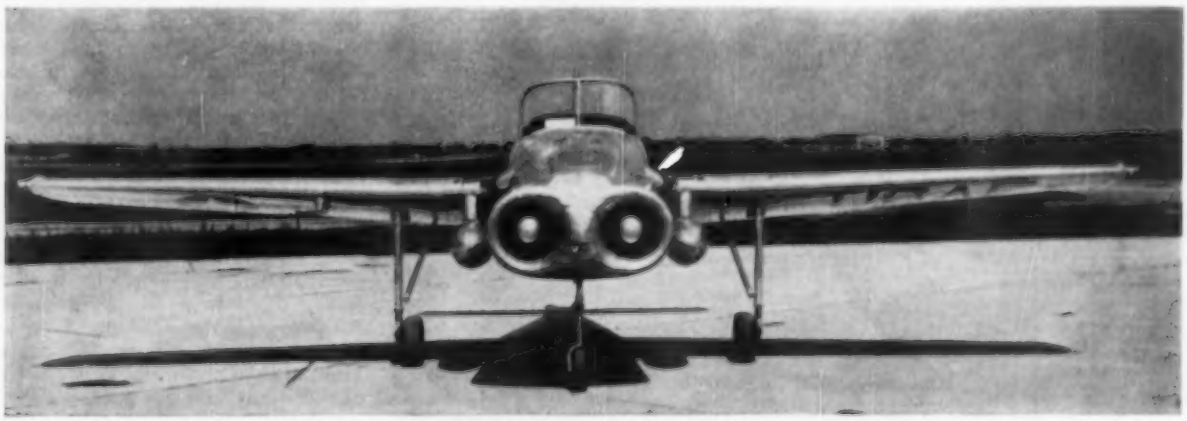
Seattle-Renton reductions will result from completion of certain tooling projects, assignment of advanced B-56G production to Wichita, "certain schedule adjustments brought about by changes in Air Force procurement policy," and the usual drop in work force which occurs once production is well under way, Boeing said.

### Chance Vought Aircraft Inc.

Chance Vought's work force is up to 18,000 from 12,500 of a year ago, when the company was between production programs on the Cutlass and Crusader. With Crusader and Regulus II missile in production and F8U-3 in development, work level is not expected to change appreciably. Most of the gain in the past year has been in production workers, but some engineers also have been added.

### Temco Aircraft Corp.

Temco employment is about 10,300, down slightly over the past few months



## X-14 Cost Cut by Component Purchase

**Bell X-14 VTOL test vehicle, shown here in drag profile, is made up of wings, ailerons and landing gear from Beech Bonanza four-place executive aircraft and empennage from the Beech T-34 Mentor military trainer. Beech believes this inter-company cooperation saved Bell over 50% on the cost of the experimental X-14 (AW July 8, p. 50). Use of these components does not mean Bell is committed to using them for any future production. Bell used similar approach on its first VTOL combining a Schweizer glider fuselage with a Cessna 170 wing. Two Armstrong-Siddeley Viper ASV.8 turbojets power the X-14. Vanes direct the exhaust downward for vertical flight.**

but up 6% from a year ago. Position as a well-diversified subcontractor means Temco's work has been relatively stable in recent months, and the company expects this to continue. Production orders for T-1 trainer, XKDT-1 drone or Corvus missile could increase work force considerably.

### McDonnell Aircraft Corp.

McDonnell employs 27,000, and backlog of missile and aircraft orders—which so far have missed budget cuts—is expected to keep this relatively stable. Production includes F3H-2 Demon, F-101A and F-101B, Talos missile propulsion and airframes, and development includes F4H Navy fighter, Quail and Triton missiles.

### Bell Aircraft Corp.

Bell employs 14,000, down about 1,500 from the first of the year. No further reductions are expected, and hiring may increase if present prospects materialize. Four different divisions employ production workers, and production contract for Rascal, for example, would increase hiring rate. Some engineers are being hired now in certain categories. Further development contracts for X-14 VTOL and Aircraft Carrier Landing System might spur hiring of engineers.

### Grumman Aircraft Engineering

Grumman's total employment is 15,000, with 13,500 at the Bethpage plant and 1,500 at Peconic jet assembly and test plant. No layoffs or increases in engineering, production or administrative workers are expected. Replacement hiring will continue to keep employment at present level.

### Republic Aviation Corp.

Republic's current employment is 17,300, with 16,800 at Farmingdale, N. Y.; 200 at the Hicksville, N. Y., plastics and guided missiles plant and 300 at the Mineola, N. Y., guided missile engineering facility. Cutback of 4,000 announced last March was trimmed to 2,000 and is now completed. It included normal turnover. Military picture is as unclear as at other companies, but possibility of building Alouette helicopter or Caravelle jet transport under license means employment could increase.

### Hamilton Standard Div., UAC

Hamilton Standard employs 11,085 and foresees no reductions in any categories in the coming year. Vacancies are being filled promptly. Windsor Locks now employs 9,800 and is hiring machine operators to help meet production schedules. Hiring of another 300 machine operators within the next few months is planned. This would bring Windsor Locks' total to 10,100. Broadbrook facility employs 1,100; the engineering branch at St. Petersburg, 185.

### The Martin Co.

Martin now employs 29,000, with 23,000 at its Baltimore Division, about the same as at the first of the year, and expects no change. Better than 50% of the company's $810 million backlog is in missiles. Baltimore division is producing SeaMaster, P5M, Matador, Bullpup and Vanguard. Denver Division, built primarily to develop the Titan ICBM, is now close to its 5,000 employment goal, expects no fluctuation. Any unexpected reductions would result in attempts to absorb employes affected in either Baltimore or Orlando divisions. Orlando Division now employs 1,500 and still will be building to an unannounced goal for some time. Facility is designed for smaller weapon systems and electronics, and projects are heavy on engineering. Division, now in temporary facilities will move into new plant about Oct. 1 to produce Lacrosse, Missile Master and Bullpup. Bullpup will continue to be split between Baltimore and Orlando.

### Pratt & Whitney Div., UAC

Pratt & Whitney employs 42,000. This is up from 39,500 from the first of the year. Plans were announced early this year to hire 5,000 new people. About half of these have been hired now in engineering, production and administrative categories, and there is no indication yet that hiring will stop. Much depends on military procurement programs. Heaviest hiring so far is in production. Major portion of new employment is at North Haven plant, where work force has doubled in the past year. New employment is almost certain at new Florida plant after the first of the year. Original plan was to hire 200 by the end of the first year and 2,000 by end of second year.

### Westinghouse Gas Turbine

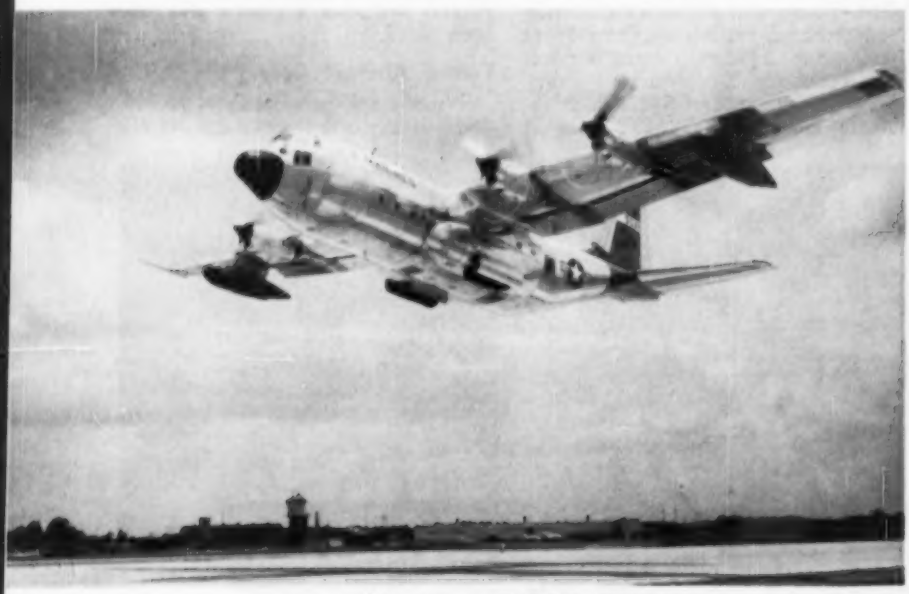
Westinghouse's Turbine Division employment is at approximately 3,500 and no change is expected. About one-third is engineering, two-thirds production and administration. Development work on the J34 engine and production of the J34 and spare parts for the North American trainer, and overhaul on the J46, are expected to keep any reductions from being necessary. Other projects in the works could result in increased hiring.

### Westinghouse Baltimore Divisions

Westinghouse's three defense divisions in Baltimore employ a total of 6,400. Breakdown is approximately 4,000 in Air Arm Division, 1,800 in Electronics and 200 in Ordnance. Total is down about 100 from the first of the year. Outlook is a slight general increase in employment in all three divisions, primarily among scientists, engineers and technicians.

### General Electric Co.

General Electric's Aircraft Gas Turbine Division employs 23,000, about



## Marine C-130 Flies

**Tanker version of Lockheed C-130 Hercules, which Marine Corps will test, makes first flight at Lockheed's Marietta, Ga., plant. Test airplane carries two 506 gal. fuel tanks in the fuselage, but a production version would have at least a 6,000 gal. tank. Wing pods contain motor driven reels and drogues for refueling fighter aircraft.**

## Breguet Taon Flies

**Breguet 1001 Taon, NATO version of the Breguet 1100 support fighter, makes its first flight at Milun-Villaroche near Paris. Taon externally appears identical with Breguet 1100 flown at Paris Aeronautical Salon (AW June 10, p. 29) and closely resembles original Breguet 1100 (AW April 29, p. 31). Taon is powered by early version of the Bristol Orpheus engine delivering about 4,000 lb. thrust, while the 1100 has two Turbomeca Gabizos of 2,400 lb. thrust each. Taon has drooped leading edge flaps, low set slab tail, nose strake for stability. Other entries in the NATO lightweight fighter competition scheduled to begin this fall are are Fiat G. 91 (AW June 10, p. 50) and Dassault Etendard VI (AW July 29, p. 27). Both have been flying.**

the same as the first of the year. Future plans were not available due to shutdown of the division for vacation. Current breakdown is: Production Engine Department, 9,000; Flight Propulsion Laboratory, 2,300; Jet Engine, 3,700; Small Aircraft Engine, 6,000; Aircraft Accessory Turbine, 2,700. Defense Electronics Division employs 20,000, up 2,300 from the first of the year.

Missile and Ordnance Systems Department stands at 6,000, up 1,000 from the first of the year, and is expected to stay about the same. Heavy Military Electronic Equipment Department has 6,500, up 1,300 from Jan. 1, and will remain the same. Light Military Electronic Equipment Department's employment at the first of the year and now is 6,700. This is not expected to change.

### Curtiss-Wright Corp.

Curtiss-Wright employs 28,000 in 11 divisions. Company policy prohibits giving an employment breakdown by divisions. Navaho cancellation recently caused the layoff of about 500 employes at the Wood-Ridge, N. J., plant, most of them engineers and administrative people. Because Curtiss-Wright's policy calls for increasing production of civilian products, increased employment is expected. Civilian sales for the first half of 1957 accounted for 60% of total sales, in contrast to 20% a few years ago.

The large portion of this is sale of turbocompound engines to airlines. Utica Bend Division at South Bend, Ind., which is concerned mostly with building and modifying trucks, now has rising employment in engineering, administrative and production personnel.

### Bell Helicopter Corp.

Bell's work force of 2,869 represents a gradual reduction of more than 500 from early this year, and further gradual reductions are expected over the coming year. They will be accomplished both through normal turnover and layoffs, since turnover rate is not high. Reductions will be in engineering and management as well as in production workers. Past reductions have been the result of trimming fat out of the operation, but the future may be dictated more by the apparent shortage of procurement funds. Army order for the H-40 could reverse the situation.

### Sikorsky Aircraft Div.

Sikorsky employs 5,964 at Bridgeport, Conn., and 5,376 at Stratford for a total of 11,340, and no reductions are expected in any category. Engineers are being replaced if they quit.

### Vertol Aircraft Corp.

Vertol's employment is now at 4,200, down from 4,800 at the first of the year. Based upon orders at hand, it is expected to continue to decline. Engineering employment was reduced earlier this year, and no further engineering decrease is expected. Direct manufacturing labor is expected to be reduced and other categories brought into balance. Reductions will be spread among export, military, commercial and subcontract areas. Substantial proportion of the decline is expected to be handled through attrition. Employment in the Delaware Valley is high, and so attrition is high. Sales between now and the end of the year will determine the future situation. Vertol recently established a department to seek aircraft, missile and electronic business. It also has sold helicopters to Sweden, its third European customer so far. Backlog on June 30 was $62 million. Net earnings for the first half of this year were $588,358, down from $1,131,436 in the first half of 1956. Decline was due to an increase of $950,000 in charges for company sponsored research and development.

### Kaman Aircraft Corp.

Kaman's current employment is 1,200, and no reductions are foreseen for the next year. Engineers are being hired at the rate of five a week, and this will continue for two to three months. Hiring is attributable to an Air Force contract in the offing and to the growing need for additional research.

## Lockheed Missile R&D Unified in Bay Area

**Los Angeles**—Lockheed Aircraft Corp.'s Missile Systems Division will consolidate all research and development in San Francisco Bay area. Production support will be the principal activity of the division's Van Nuys, Calif., plant.

Unification of the division's entire research and development organization in the Bay area will permit optimum utilization of technical personnel and facilities without duplication of effort, important in the development and test of the Navy Polaris IRBM and other projects.

# USAF Leaders Emphasize Austerity

By Claude Witze

**Washington**—Signposts pointing to new USAF procurement policies, forced by technological revolution and the budget pinch, were revealed to the aircraft industry last week at the 11th annual convention of the Air Force Association.

Among them were:

- **Barring an unexpected increase** in rate of expenditure permitted, inflation alone may cause further stretchout of aircraft procurement programs before Fiscal 1959.
- **Screening of development projects** will continue and more of them will be abandoned.
- **Research and development policies** face a major shakeup with USAF resorting to multiple sources when it feels that the resources of more than one company are needed to do the best possible job.
- **Contract maintenance and overhaul** expenditures will be reduced. In this case, no change in policy is contemplated, but USAF will avoid IRAN service for "a good many second-line aircraft," while still maintaining an austerity standard in its own overhaul depots.
- **Tougher competition** will take its toll from major prime contractors, subcontractors and vendors. But USAF will discourage primes from filling their own voids by more in-plant production.

Panels of top level USAF military and civilian officials, headed by Air Force Secretary James H. Douglas, outlined their service's changing requirements at an all-day session for industry representatives. Separate presentations were given by USAF headquarters, the Air Materiel Command and the Air Research and Development Command.

### 'Severe' Pressures on R&D

Richard E. Horner, USAF Assistant Secretary for Research and Development, warned bluntly that "the pressures are unrelenting and promise to become increasingly severe."

He said his office is going to "take a hard look at our programs, review our policies . . . and test their applicability for the period ahead."

"If you assume a balanced program to begin with," Horner said, "it is not practical to make all of a necessary saving from the procurement end of the program, for example, while retaining business as usual in research and development, and still achieve a balanced program as an end position.

"Thus we will have a reduction in the resources available to research and development. We cannot justify filling the shelves . . . with components we cannot afford to integrate into developed weapon systems.

"Nor can we develop systems which we cannot afford to produce, maintain or operate."

### R&D Problems Cited

Horner indicated he has found some companies investing money and talent in projects that do not fit the USAF program because they have gone ahead without getting a firm confirmation that the requirement existed.

In his new effort at program reduction, one severe problem is that capability and facilities are not always located in the same place and easily aligned with project needs, Horner said.

Facilities and organizations in many cases are highly specialized, Horner said, and it will be difficult to use all the resources while maintaining the competitive system to seek out the best engineering solutions for USAF problems.

"It can be seen," he said, "that a contradictory situation might be created where one company might propose a superior technical solution whereas preponderance of the necessary facilities and technical manpower might be located with another company. There is no completely satisfactory solution to such a dilemma . . .

"One of the most satisfactory compromises may be the increasing use of multiple-source contracts for development; where two or more companies are invited to jointly contribute to the accomplishment of a project, each providing the services for which they are best fitted."

Horner said he is confident the industry can work with company-to-company agreements and promised that the details will be left up to the contractors. He acknowledged that there are severe complications involving proprietary information, cross-licensing and follow-on procurement.

### Further Budget Cuts

Secretary Douglas gave his first report to industry leaders since the recent Pentagon conference on changing USAF procurement policies. (AW June 24, p. 26).

These developments have taken place since that time, Douglas said:

- **USAF budget has been cut** by more than $500 million.
- **It has become "clearly necessary"** that USAF slash contemplated Fiscal 1958

expenditures by nearly $1 billion.

• **Personnel ceiling** has been cut by 25,000 effective Dec. 31.

Douglas gave the industry credit for seeking new economies in overhead, overtime and inventory levels but said there still is room for improvement. Too many of these costs are "among the things we have taken a bit for granted," Douglas said. He urged further action to reduce the spending rate.

On the subject of slowdowns, some of which he had announced a week earlier, Douglas said USAF modernization certainly will be delayed by the action. On the other hand, he said, "we will certainly get a better product into the inventory and the companies concerned can expect greater stability than under the previous schedules."

Douglas said his office is being pressed for details but that he is willing only to say:

• **McDonnell production (F-101B)** should remain relatively stable.

• **Republic output of the F-105** "will be at a very low rate until we are able to secure the improved all-weather model that we require."

• **Production rate of the Lockheed** F-104 will increase but not up to the rate planned in earlier schedules.

• **Schedule of the Convair F-106** will not be effected for more than a year.

The secretary warned that the screening of development projects has not stopped with the limitation of the North American Navaho missile. Studies are being continued on a priority basis and "a number" of less urgent projects will be postponed or "fall by the wayside."

Both aircraft modification and new industry facilities were brought into the picture by Douglas. USAF plans fast action to slow down major production if the aircraft coming off the line will require major modification, he said, because some of this work is not justified in view of the high cost. USAF also will be "very cautious" about authorizing construction of facilities if

## Bendix, Ricks Races

**Washington—Poor wind conditions between Chicago and Andrews Air Force Base, Md., handicapped six Air Defense Command pilots in Convair F-102 jet interceptors in this year's Bendix Trophy Race, kickoff event for the Air Force Association's 11th annual convention.**

**Winner was Capt. Kenneth D. Chandler of the 343rd Fighter Group, who covered the 619.73 mi. course at an average speed of 679.053 mph. This was only 12.392 mph. faster than last year's Bendix speed of 666.661 mph. set between Victorville, Calif., and Oklahoma City, Okla., by Capt. Manuel J. Fernandez, Jr., in a North American F-100C.**

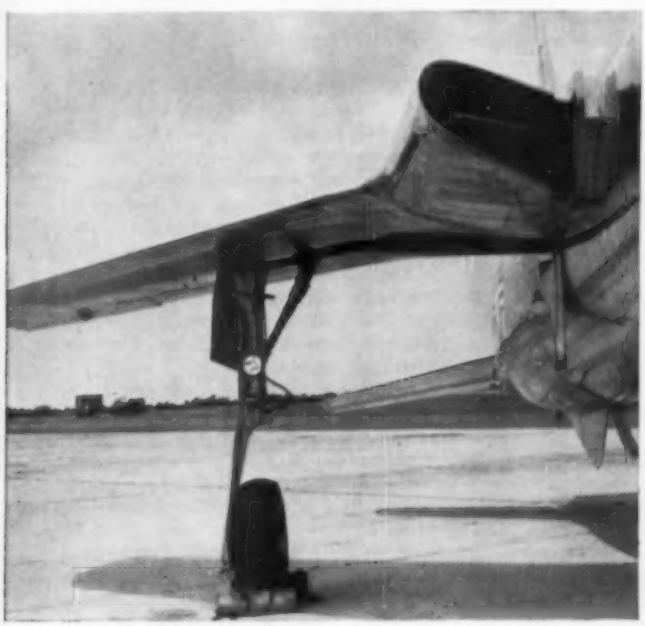
**The F-102 pilots encountered no winds over most of the trip from O'Hare AFB and met slight head winds as they neared the Washington area.**

**Aviation Week was told that on a practice run prior to the AFA show one of the competing planes covered the course with a favorable tail wind at an average of 810 mph.**

**In addition to Chandler, pilots in this year's Bendix race who bettered the 1956 record were: Col. Robert L. Gould, 672.645 mph., Capt. LeRoy W. Svendsen, Jr., 672.563 mph. and Capt. Martin O. Dettle, 667.094 mph.**

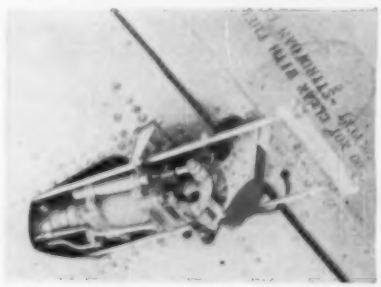
**Second race of the AFA show was the Earl T. Ricks Memorial Trophy Flight for Air National Guard pilots. It was flown in Republic F-84F jets from Fresno, Calif., to Andrews with refuel stops at Tucson, Ariz., Dallas, Tex., and Atlanta, Ga.**

**Winner was Maj. Peter R. Phillipy of the 112th Fighter Interceptor Group at Corapolis, Pa., who covered the course in 4 hr., 13 min., 40 sec. for an average speed of 638 mph.**



**REPUBLIC F-105B's novel swept forward sharp-lipped air inlet (above) features a hydraulically actuated movable wedge for maintaining the optimum airflow shock pattern within permissible limits during a wide range of aircraft speeds. Clean-lined main landing gear with close-fitting wheel fairings is designed to provide minimum drag when extended. Large five-piece lateral control spoilers (right photo) are extended on top wing surface ahead of slotted flaps, shown rolled out on their internal tracks. Four-piece petal-type air brakes nestle around variable area afterburner exhaust (left), provide rapid deceleration without requiring trim changes. Low-set slab-type stabilator is used. Balanced rudder is fitted with buzz dampers, lower portion of fin leading edge has intake for afterburner cooling. For additional F-105B photos and data see cover and pages 74-75 (also AW July 29, p. 28-29).**

**SWIVELING TAILPIPE** and wingtip nozzles provide extremely accurate control of Ryan X-13 Vertijet in hovering and near-zero speed flight regime. Vertical and horizontal movable control surfaces are actuated by conventional stick and rudder in level flight.



**PORT INLET** (left) for X-13's Rolls-Royce Avon has curved inner wall, flush bullet. Screen keeps out foreign objects. Complex actuator (center) for elevator-aileron conventional controls has adjustable balance weight. Movable surfaces have Styrofoam cores. Nozzle (right) is swiveled to rear.

the work can be done in some existing plant.

Douglas pointed out that USAF expenditures set a new peacetime record in Fiscal 1957 and said Fiscal 1958 will rank second. For aircraft and related procurement this means $7.5 billion in Fiscal 1957 and $7 billion in Fiscal 1958.

In reply to a question, he said that these figures make no allowance for continuing inflation and that Defense Department total expenditures must be held within the administration's goal of about $38 billion a year. Douglas said public pressure is high for curtailment, yet he indicated it may be necessary for the total to hit $40 billion in Fiscal 1959 if the services are to maintain the present level of capability.

USAF's Air Materiel Command faces a revolution in its logistics operations and a drastic phasing out of the overseas depot structure in order to meet the demands of missile warfare, industry delegates were told by officials from Wright-Patterson AFB.

Gen. Edwin W. Rawlings, AMC commander, and Maj. Gen. K. E. Tibbetts, his director of plans and programs, emphasized that AMC's physical plant will shrink with the slow phase-out of manned aircraft and stockpiles will be reduced.

Gen. Rawlings made it clear that AMC planning does not look to a sudden revolution in weapon systems and that the long-range outlook includes improved logistic support for manned combat units "for an indefinite period of time." But AMC is making sure it will be able to support missile systems as they are phased in.

Another speaker indicated that he expects manned aircraft to be in USAF's weapons arsenal for at least another 15 years.

Without reference to improved air transport capability and the types of equipment that will be needed to do the logistics job, Gen. Tibbetts said AMC's future picture will include:

- **A global logistic command,** organized along weapon system support lines.
- **A high speed communications** system for rapid transmisison of logistical information.
- **Electronic data processing** capability that will permit fast delivery of items needed in the field.
- **High speed transport** capability.

Both Gen. Rawlings and Gen. Tibbetts emphasized that missiles "must fight their way in" to a permanent place in the USAF arsenal by displaying performance superior to that of manned aircraft. And the problems of electronic reliability and flexibility, Gen. Tibbetts said, "are truly staggering."

Once guided missiles are operative, AMC's biggest task will be to keep all of the weapons at each site in combat-ready condition. Faulty missiles will be returned to a central overhaul point, because tooling and test equipment for small missiles will cost more than $2 million. Spares must be kept at a minimum because the weapons themselves will be expensive.

In the case of the larger ballistic types, one or two tank cars of fuel will be needed for a launching. The guidance system must be more refined. Automatic ground handling equipment must operate "with the speed of lightning."

The ICBM will require forward in-

## Weapon Review Urged

**Washington—An objective evaluation of weapon systems, with elimination of all that are obsolete or marginally efficient, was urged on Congress last week in a policy statement presented to the Air Force Association with approval of its Board of Directors.**

**The evaluation, labeled a "lie detector test" by Sen. Stuart Symington (D.-Mo.), former USAF Secretary, was not recommended for any specific weapon system but obviously would be applied to Navy's aircraft carrier complex as well as Army and Navy missile programs. Tests would be conducted under a commission responsible to Congress.**

**AFA also was expected to call on Congress to appropriate sufficient money to bring the Air Force up to full strength, speed air defense capability and intensify research and development.**

stallation of teardown facilities with provision for evacuation only of components for overhaul and modification.

In both cases, USAF's objective will be to buy as few missiles as possible and keep as many as possible in combat-ready condition. It was emphasized that improved high speed transport will be vital to the operation.

The industry audience was told there is an "absolute necessity" for the achievement of greater output for man-hours of labor expended through the wide adoption of automation.

Lt. Gen. Clarence S. Irvine, USAF Deputy Chief of Staff for Materiel, said manufacturing technology in the industry has not kept pace with the advances in its product. Aircraft and missile makers must give increasing attention to new materials and engineering solutions to their problems.

USAF, Gen. Irvine declared, must be selective in choosing its sources—"pick only the best horses"—and make sure there is closer contact between these sources and the using command.

Dudley S. Sharp, Assistant Secretary of the Air Force for Materiel, supported Gen. Irvine's views. Sharp said he can see no reason why overhead has to be increased in an aircraft plant where production volume has been reduced. He insisted there still is room for overhead cuts.

For the subcontractor, Sharp said he recognizes there will be increasing pressure to pull work back into the plant of the prime weapon system contractor. But he called for resistance in the interest of maintaining a broad production base.

Sharp emphasized that spending must be monitored more closely and insisted that the industry can survive under the new conditions while USAF gets better equipment.

# Aerial Jeep Contracts Awarded

**Washington**—Automobile industry made a new bid to enter a phase of the aviation business last week when Chrysler Corporation was awarded a $661,000 contract to build an aerial jeep research vehicle for the U. S. Army.

Chrysler's competitors in the design, construction and testing program are Aerophysics Development Corp. of Santa Barbara, Calif., with a $388,000 contract and Piasecki Aircraft Corp. of Philadelphia, awarded a $653,000 contract.

Aerophysics is a subsidiary of Curtiss-Wright Corp., acquired last year when the engine manufacturer took over control of Studebaker-Packard Corp. The company in the past has worked on hypersonic test vehicles and the Army's Dart missile. In addition to the aerial jeep, it has submitted proposals in helicopter and STOL competitions.

The three jeep contracts, totalling $1,702,000, were awarded by the Transportation Research and Engineering Command at Ft. Eustis, Va. A total of 21 companies, including many of the leading manufacturers of both fixed and rotary-wing aircraft, took part in the design competition.

The contracts call for development of flying research vehicles to explore the behavior of ducted propellers in this type of design and to determine the most promising control system.

Army will get a total of six vehicles, two from each contractor, if all contracts run to completion. Work is divided into three phases: preliminary design and wind tunnel testing, construction and flight test. The contracts provide for a close review of the work after the first phase, a point at which the Army can halt a project if it is not sufficiently promising.

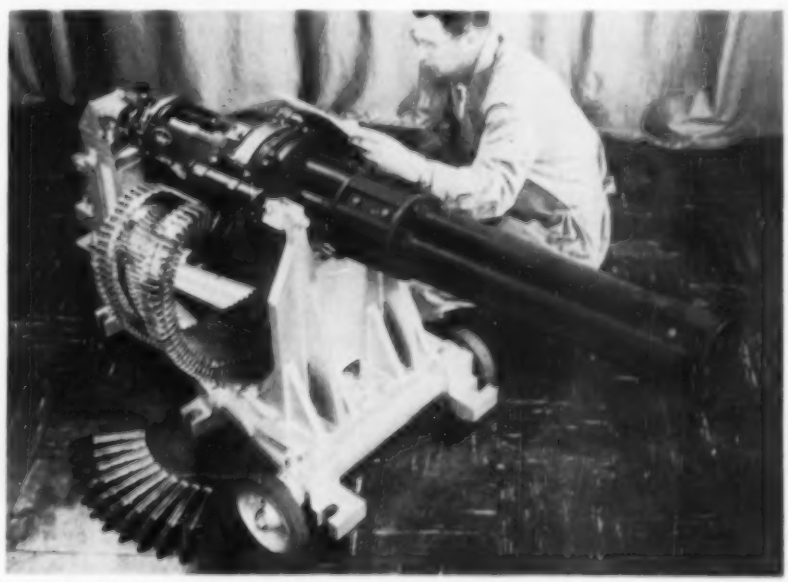
Aerophysics design incorporates four fans, a proposal that should result in stability advantages but might result in some complications in mobility and shipping. Size of the contract, nearly half of the price set for the Chrysler and Piasecki designs, indicates the Aerophysics design probably has an advantage in mechanical simplicity.

Both the Piasecki and Chrysler proposals involve two ducted fans. Piasecki would provide control with deflector vanes; Chrysler favors a mechanism to move the entire duct and shift the blast of air.

Chrysler's entry was prepared by its Defense Products Division. There are indications that Chrysler is expanding its interest in aeronautical items and has submitted design proposals in new competitions now contemplated by the Army and other services. It is understood the company already has built a small experimental model.

Army spokesmen say the aerial jeep eventually should be a general utility vehicle capable of carrying a 1,000 lb. payload of men, weapons or equipment. Speed will be in 50 mph. range. Weight empty also should be in the neighborhood of 1,000 lb.

Maj. Gen. Hamilton H. Howze, director of Army Aviation, has said the vehicle may mount radio equipment, machine guns or a 106 mm. rifle.



**NEW 30 MM.** Vulcan cannon which has twice the striking power of earlier 20 mm. model was developed by General Electric's Missile and Ordnance Systems Dept. under Army contract. Cannon was unveiled at AFA convention in Washington.

# Defense to Stop Just Pleading; Reliability Will Go in Contract

By Philip J. Klass

**Washington** — Defense Department shortly will reveal plans to make reliability a well-defined contractual requirement instead of merely a much-sought objective. New program will be the most specific and comprehensive reliability effort ever attempted by Defense Department and holds important implications for both avionic equipment and component manufacturers.

The all-out reliability program is the result of an 18-month effort by nine industry-military task groups to get at the basic roots of unreliability in military electronic equipment. They worked under Defense Department's AGREE (Advisory Group on Reliability of Electronic Equipment).

### AGREE Program

The AGREE program, first reported by AVIATION WEEK (March 12, 1956, p. 249) is spearheaded by James M. Bridges, Director of Electronics, Office of Asst. Secretary of Defense for Research and Engineering.

Here are some of the "contractual teeth" which Defense is expected to reveal for introduction into future production and development contracts:

• **Required reliability,** probably expressed in terms of the percentage of total equipments delivered which must operate without failure for a specified number of hours in actual service.

• **Specific test procedures** and conditions which contractor must employ to prove to contracting officer that development, prototype or production equipment has a statistical probability of meeting the aforementioned mean-life requirement prior to government acceptance.

Procedures applied to development, prototype and production units probably will differ slightly.

• **Reliability prediction,** based on analytical study of paper design and test data which shows most susceptible modes of failure. This appears certain to become mandatory for production equipment, perhaps for development models as well.

• **Demonstration of maintainability,** by means of prescribed tests under simulated field conditions in which faults must be located and repaired in a specified period of time.

These are but a few examples that indicate that the Defense Department is through begging industry for greater reliability and now is going to start contracting for it.

Present military specifications on components, the procedures used to prepare them, and the qualification test procedures used to determine whether a manufacturer's component meets the specifications appear due for a complete revision—but on an evolutionary basis.

Task Group No. 5, which analyzed the component problem, was extremely critical of present procedures in its final report: "Present military component specifications do not assure the achievement of presently needed reliability levels," the report says.

Present MIL specs fail to reflect the true end-use requirements because the environmental conditions called out do not correspond to those which the components will meet in actual use, Task Group 5 said. Furthermore, the MIL spec tests do not provide failure rate data needed for reliability prediction, the report adds.

Another serious deficiency scored by the group is the lack of "policing" to assure that a manufacturer, whose component has once qualified for MIL approval, does not accidentally or intentionally let quality slip in subsequent production.

As a result of these recommendations, Defense is expected to make following changes:

• **Semi-annual requalification** tests of all components, to assure maintenance of original quality and to evaluate their reliability, will be required.

• **Larger test samples** will be required for qualification tests to establish failure rate data for reliability studies. Later, specifications may be revised to call for more extensive testing under variety of environmental conditions to provide data on critical component failure modes, parameter changes and relationship between failure rate and test environment.

• **In-plant quality control** to minimum government standards probably will be required for MIL-approved component suppliers. Periodic Defense Department inspection and approval will be required for manufacturers to retain component qualification.

### No ASPR Changes

After study of Armed Services Procurement Regulations, Task Group No. 6 concluded that no modification is needed to accommodate new reliability program. Mean-life, maintainability and other new reliability criteria can be introduced into equipment specifications in the same way that operating characteristics are now included, the group reported.

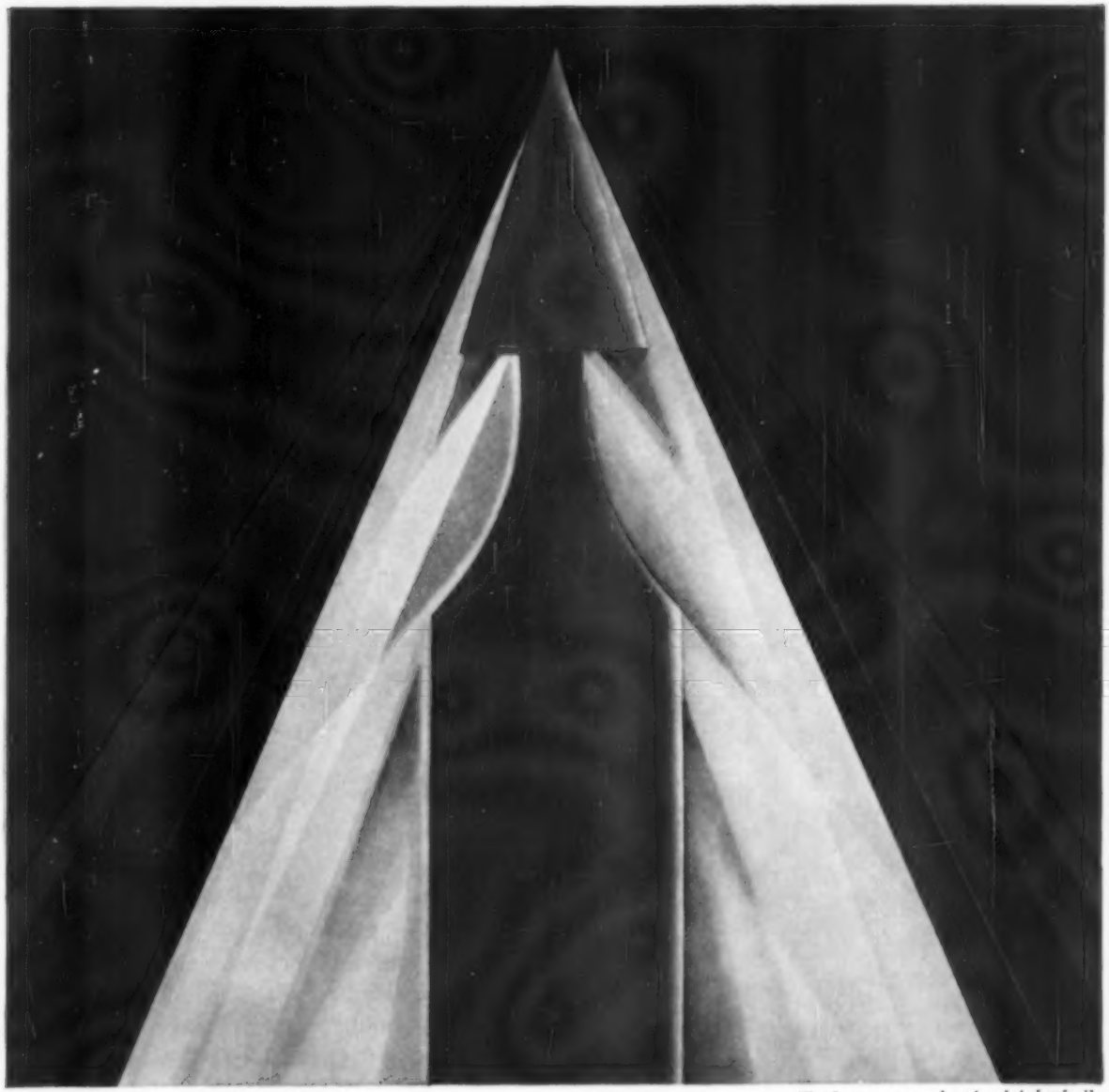
Procedures for tests intended to measure equipment reliability have been carefully designed to make them reasonably immune to tampering by contractors or by testing personnel. Certain redundancies are intentionally introduced in the test procedures to make tests self-checking and relatively unsusceptible to data recording errors, it is reported.

If Defense Department action follows task group recommendations, these basic reliability test procedures will be applied across the board by all the services.

Standard detailed testing procedures

**Scimitar Goes Into Production**

**Supermarine Scimitar strike fighter for the Royal Navy has been placed in production although many advanced aircraft projects have been abandoned by the British government. Only new feature apparent on the production model is the small wing fence. Basic design is at least eight years old and has produced numerous variations.**



*Shock wave around a simulated missile*

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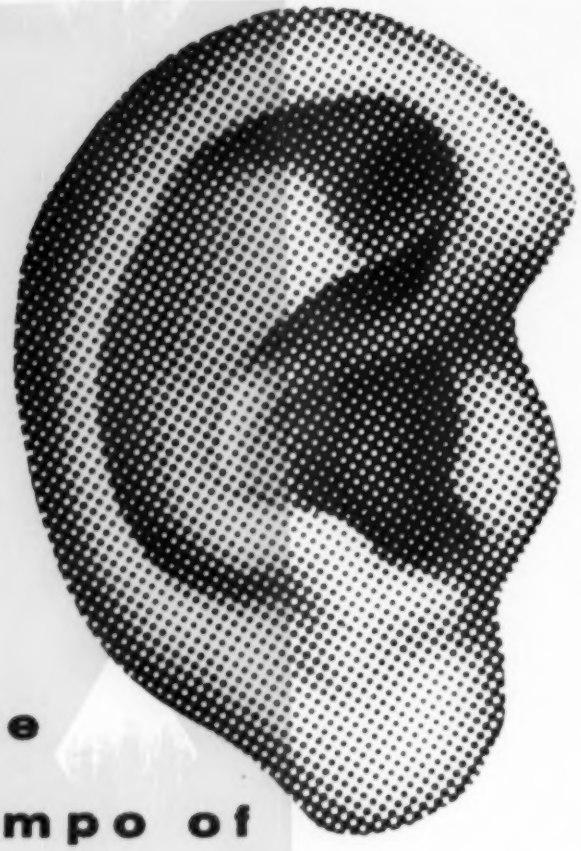

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and rules for administration will be used by all procuring agencies.

Only those factors peculiar to the type of equipment and its end-use environment will be left to the discretion of the procuring agency, if task group recommendations are accepted. Factors that can not affect the results of the reliability evaluation, but which might determine testing convenience, will be left to the option of the procuring agency or contractor.

Figures for minimum acceptable life (to failure) for different types of military electronic equipment were determined by Task Group No. 1.

The Task Group analysis did not include missile-borne equipment, security sensitive equipment or large data-handling systems like SAGE or Missile Master.

Out of the study has come a tabulation of each major type equipment according to using service, giving minimum acceptable mean-life to failure. These figures form the basis for new Defense Department specifications.

Some equipment types appear in more than one tabular location with different mean-life requirements depending upon how the equipment is used tactically. This means that the procurement agency must either standardize on the longest mean-life or else procure the same equipment to different reliability standards. The former appears more likely.

Task Group 1 acknowledges that its mean-life figures are only best-estimates and should be revised if further study provides more valid information.

Other recommendations made by the task groups, which reportedly stand a chance of Defense adoption:

- **Supporting test equipment,** spares, training material should be purchased at same time that contract is awarded for production of new equipment.
- **Single set** of environmental test conditions for component failure rate evaluation should be adopted by all services.
- **Permanent industry-military** group should be formed at Defense Department level to develop new military component specifications and develop better inspection techniques. Group would also accumulate usage, failure reports, seek to correlate specifications, manufacturer's quality control data and actual field experience.
- **Formation of independent** reliability group to supervise industry's efforts in failure prediction and analysis. Task Group 2 says the group must not be subject to interests or prejudices of project personnel on the staffs of the contractor or procurement agency. Reliability Research Dept. of Aeronautical Radio Inc. currently is performing similar type of service for Defense Department.

# Air Force Evaluation Is Likely For Three Competing HF Systems

**New York**—Air Force evaluation of three new high-frequency communication techniques, each competing hotly for both military and airline acceptance to replace amplitude modulation (AM) system, appeared likely last week.

Rome Air Development Center, currently conducting fully instrumented side-by-side flight evaluations of the Collins suppressed-carrier single sideband system and General Electric's synchronous detection, will include the compatible single sideband system developed by Kahn Research Laboratories, providing it can be loaned the Center.

Spokesman for Kaiser Aircraft and Electronics Co., which holds military rights to the Kahn system, says he hopes to work out details this week and it appears that equipment can be delivered to Rome within 90 days.

Kahn earlier agreed to loan to Aeronautical Radio Inc. an adapter for converting one of Arinc's New York station transmitters to enable it to evaluate the economics and problems of such conversion in the event the airlines adopted the Kahn system.

Arinc recently tried to arrange an informal airline evaluation of the Kahn and Collins systems, although Arinc's William Carnes says this was not the original objective of making the Kahn installation at New York. Collins tentatively agreed to supply its equipment to Arinc, later withdrew.

The reasons, according to its spokesman, were:

- **Major international carriers** believed results from New York installation tests would not justify trouble and expense of installing Collins airborne equipment. They believe test installation should be made at Gander and/or Shannon-London to determine which system is superior under critical North Atlantic operating conditions where atmospheric disturbances now cause frequent outages of existing AM equipment. (Kahn-type transmissions can be received with AM equipment.)
- **Limited current production** of single sideband equipment, coupled with heavy military demand, made Collins reluctant to divert for Arinc tests in view of international carriers' attitude.
- **Numerous tests** already are under way on Collins system by Rome Air Development Center, Strategic Air Command and Navy.

These, Collins, says, should be adequate to establish its merit.

Pan American and Trans-Canada Air Lines representatives confirmed to AVIATION WEEK that they doubted whether results of the proposed Arinc competition would justify effort to participate in them.

PanAm suggested tests at Gander and Shannon-London.

Collins recently visited TCA to enlist its aid in setting up a single sideband installation at Gander for airline evaluation in the North Atlantic, a TCA official told AVIATION WEEK. TCA talked Collins out of the move because it believes such action is premature at this time, the official says. He believes the North Atlantic carriers first must find a better definition of their communications problems to determine whether present AM should be abandoned before trying to resolve relative merits of single sideband.

Kahn has publicly raised the question of why "Collins refused to enter into competitive single sideband tests." One company official says the Collins system is not feasible for air-ground use and that this can be proven in the New York area without expense and trouble of North Atlantic installations.

Dr. Joseph Vogelman, civilian chief of Rome's Communications Laboratory, says its flight tests show that "telephone quality" can be obtained with the Collins system over distances of several thousand miles. Tests have been run at 14, 21 and 26 mc. Vogelman adds that the GE synchronous detection receiver's performance generally has equalled that of single sideband reception.

Rome has carefully instrumented its C-131 to provide a scientific basis for comparing performance of systems under test. Magnetic tapes with prerecorded messages and words designed to test articulation are alternately transmitted over each system, both ground to air and air to ground. Received message is recorded on tape for analysis.

## Britannias for TWA?

**Washington — Agreement between Howard Hughes and Bristol Aeroplane Company for the purchase of a fleet of Bristol Britannias for Trans World Airlines last week hinged on the outcome of British cabinet-level discussions on the transaction. Because the purchase of 30 Britannias by Hughes would require British Overseas Airways to relinquish orders for its Britannias, top-level governmental approval is necessary. BOAC has received delivery on 10 of its 19 Britannias, probably would fill the equipment gap by ordering DC-7Cs at a substantial dollar gain for England.**

# CAB to Give CAA Airspace Control

**Bitter issue appears to be headed for settlement; military withholds comment pending further study.**

Washington—In an unprecedented action, the Civil Aeronautics Board last week proposed to give the Administrator of Civil Aeronautics authority to resolve the bitter controversy between military and civil aviation over the allocation of U. S. airspace (AW May 27, p. 21 and p. 40).

Effect of the ruling would be to strip the Air Coordinating Committee's Airspace Panel of its present authority to handle airspace conflicts. It also would revoke the rights of the military services to declare large areas of airspace off-limits to non-military aircraft, except in the case of enemy attack or other unusual circumstances.

Under the proposed Civil Air Regulation, the CAA administrator would have the power to designate restricted areas when he finds a "hazard to aircraft in flight exists." He also would have authority to revoke or modify any restrictions that interfere with the safe operations of aircraft.

### Airlines Applaud Action

Airlines were quick to applaud the Board action and said the move will help insure a "fairer allocation" of airspace.

Defense Department said it preferred to withhold comment until it had reviewed the proposals further.

Defense and other interested parties have 35 days from the July 30 Board announcement in which to submit comments on the proposed ruling, but it is doubtful that the Board will change the regulation substantially.

Two principle features of the proposed regulation are:

• **Establishment** of airspace restrictions. CAB has the statutory responsibility for establishing airspace restrictions and has delegated this authority to the CAA administrator. Under provisions of the new ruling, the administrator may designate restricted areas on petition of any interested party, or on his own motion when he finds this necessary to the safety of aircraft in flight. He also may impose terms, conditions and limitations on restricted areas and may modify or revoke restrictions where required in the public interest.

• **Military compliance** of air traffic rules. The proposed ruling will permit the military forces to conduct operations "necessary to the immediate national defense" but will bring to a halt any right to exercise such authority in other areas of operation without prior approval of the administrator. Training and operational missions which require a deviation from civil air regulations can be authorized by the administrator through the issuance of waivers. The Board emphasized that the ruling is being proposed to clarify present regulations, which it said never were intended to be used to justify noncompliance with air traffic rules in such operations as continuing training activities.

### Appeal Review Provided

Under the regulation, the Board has the right to review the administrator's actions.

Furthermore, interested parties will have an opportunity to submit comments on any airspace action the administrator may take.

In its notice of proposed rule making, the CAB called airspace a "national resource" that is "diminishing rapidly," and warned: "It is no longer easy to meet the needs of users by merely allocating airspace previously undisturbed by other users."

The Board emphasized that growing operational needs have created increased problems. It pointed out that in the past seven years, civil airways mileage has doubled and the number of military airspace reservations has increased more than 50%. The Board added:

"The problem of diminishing airspace has become so acute that the government can no longer accommodate all the needs of individual users and must judiciously weigh the interest of all users to determine what is most in the public interest."

### Unanimity Rule Hit

The Board criticized the need for unanimous agreement within the Airspace Panel of the Air Coordinating Committee before any airspace action can be taken and charged that compromises resulting from this voting procedure have not always been in the public interest.

Airlines previously have opposed the voting structure of the Airspace Panel and have protested that civil aviation representation on the panel has always been outnumbered by the military in deciding airspace problems. The Airspace Panel consists of six voting members—Air Force, Navy, Army, Department of Commerce, Civil Aeronautics Board and the Federal Communications Commission. Commerce represents the CAA and other agencies under its jurisdiction with its vote.

The Board admitted in its draft release on the proposed regulation that many problems have been resolved by the Airspace Panel.

However it added:

"It is now apparent that it cannot cope with the complex problem of diminishing airspace on the one hand and increased need for airspace on the other."

Prior to the public announcement of its proposals, the Board held a briefing session on the regulations in a meeting attended by Louis Rothschild, Commerce Under Secretary; James Pyle, Administrator of Civil Aeronautics; Lt. Gen. Elwood Quesada, special presidential assistant for aviation planning; and representatives of the secretaries of Defense, Air Force, Army and Navy.

## Three Lines Discuss Turboprop DC-7s

**Santa Monica—Representatives of United Air Lines, American Airlines and Flying Tiger Line met with Douglas Aircraft Co. officials here last week to discuss purchase of turboprop versions of the DC-7.**

**United appeared to show a strong interest in the DC-7T passenger version of the proposed aircraft while American and Flying Tiger discussed the DC-7D, which will be designed basically as a cargo plane. Both models will be powered by Rolls-Royce Tyne engines.**

**Base price of the aircraft is reported to be just under $3 million. Problem for all three airlines is financing, since both American and United are heavily committed on large fleets of other turbine-powered aircraft and Flying Tiger recently purchased a fleet of 10 Lockheed 1049Hs.**

**Both DC-7 versions are 10 inches wider and 80 inches longer than the DC-7C. Outboard engines will be moved further out and fin will be swept aft.**

**Comet 4 Fuselage, Wing Mated**

**Fuselage of first Comet 4 jet transport for British Overseas Airways Corp. is mated to wing at de Havilland plant at Hatfield, England. The airplane, with a 111 ft. fuselage and powered by four Rolls-Royce Avon engines to be installed soon, will fly early next year.**

# Immediate Fare Increase Vital To Early Jet Use, Airlines Say

By Ford Eastman

**Washington**—Failure to approve a passenger fare increase immediately will deprive the traveling public of modern jet air service for several more years, airlines told the Civil Aeronautics Board last week.

The warning was made in oral arguments before the CAB in the suspended passenger fare increase investigation, in which seven domestic carriers applied for a 6% increase as an emergency measure pending outcome of the general passenger fare investigation.

The Board is expected to announce its decision soon on the emergency requests.

Rising costs and dwindling profits at a time when the industry needs a tremendous amount of money to finance new equipment has placed airlines in a serious financial situation which necessitates immediate action, carriers argued. Before airlines can attract financial backing necessary to purchase the new equipment they must show a better earning record, they said.

### Bureau Opposition

CAB's Bureau of Air Operations opposed the requests, arguing that an analysis of relevant considerations shows that carriers still enjoy an economic opportunity to achieve the favorable earnings. The Bureau recommended that CAB deny the carriers' applications.

It based its case on the following:

• **Carriers have enjoyed** favorable earnings in the recent past. Each of the seven airlines, except Northwest, realized an average return in excess of 8% during the seven-year period from 1950 through 1956 and the returns ranged as high as 12.86%.

• **General economic outlook** for the industry remains good. Historically, increased traffic volumes and technical advances, including larger and more efficient aircraft, have enabled carriers to absorb continuing price and wage increases without an increase in the cost of production of available ton-miles. This situation continues. Of primary importance is the fact that traffic demand has continued strong.

• **Recent fleet additions** of larger 4-engine aircraft, plus fleet acquisitions planned in 1957, will result in an increasing proportion of traffic being carried in larger and more efficient aircraft types. This will contribute to carriers' opportunity to control unit costs.

• **Industry has raised** substantial funds for its equipment needs. In the last two years, domestic trunkline carriers have raised more than 500 million dollars under various loan agreements to provide funds for their capital needs, ranging up to 40 years for repayment. Others have raised equity funds.

The Bureau Counsel contended that the carriers could do even better financially through more economical and efficient management. An analysis of the carriers' operations made in the light of the statutory standards, the Bureau Counsel said, show that:

• **Failure to operate** at reasonably attainable passenger load factors is depressing earnings.

• **Carriers have included** excessive depreciation charges and excessive allowances for federal income taxes in their reported and forecast expenses.

• **Equipment purchase deposits** are not part of the rate base.

As a result the bureau's adjusted 1957 forecast reflected profits far greater than the carriers themselves predicted. Airlines bitterly protested the bureau's contentions as unrealistic and designed for purpose of justifying a predetermined decision to oppose the increase.

George Spater, Trans World Airlines general counsel, said: "While the airlines walk a tight-rope between bankruptcy and solvency the Bureau of Air Operations ignores this critical state of affairs which exists today and indulges in speculation of profit-making in years to come."

Spater said earnings for the domestic trunk carriers have dwindled to $14 million for the first five months of 1957 compared with $37 million for the same period last year. "This," he said, "is a clear prelude to a gradually worsening situation in the period ahead." Reflecting on the depression which confronted the industry between 1946 and 1949, Spater said none of the optimistic predictions made by the CAB staff ever materialized.

Richard S. Maurer, Delta Air Lines vice president and attorney, urged the Board to "break the fare barrier to permit airlines to continue to provide the American public with the finest air transportation system in the world."

Maurer said the nation's airlines have reached the limit of their ability to offset rising operational costs through better technological advances and more efficient management. He also said there has been no public opposition to the proposed 6% fare boost.

### Northwest Plea

A similar appeal was made by C. Edward Leasure, Northwest Airlines attorney, who cited revenue gains for the company but dwindling profits. Northwest is one of the few major airlines that has not announced completion of financing commitments with which to purchase jet equipment.

H. Templeton Brown, United Air Lines attorney, told the Board that the industry could be irreparably damaged if the level of earnings continues to drop while traffic continues to increase.

Despite recent favorable earnings, Brown said, airlines still do not enjoy a financial standing which makes needed capital readily available. During the first six months of this year United's operating revenues increased 5.2% over a similar period a year ago, but operating expenses were up 11.8%, he said. The company's operating profit for the first half of the year was down 65.1% as compared with the first six months of 1956, he said.

Other airlines presenting arguments along the same lines include Capital, Braniff, Eastern, and American. American was not an original applicant, but filed for the increase last week.

**RUSSIA'S** Tupolev 110 four-jet transport bears a family resemblance to the smaller, twin-engined Tu-104 (AW July 22, p. 27). Arrow pinpoints what appears to be new, spliced-in fuselage section forward of wing leading edge. Otherwise fuselage window arrangement is identical to Tu-104. Turbojet will carry 100 passengers, compared to 50 in Tu-104, up to 180 in Boeing 707 or Douglas DC-8.

# Aeroflot Told to Advertise, Push Sales

Aeroflot, Soviet-owned airline, is launching the biggest advertising and promotion campaign in the history of Communist civil aviation on orders from a high-ranking agency of the USSR Council of Ministers.

The government instructions to the airline to "propagandize" its services coincide with an important reversal in Russia's basic attitude toward advertising. Although Soviet officials still claim that capitalist advertising is based on falsehood and deception, they now assert that "truthful and informative" Communist advertising is good and necessary.

Aeroflot has started its campaign with the placement of full-page, color ads in USSR's most popular magazine, Ogonyok, which has a circulation of 1.2 million. The ads feature the Tu-104 jet transport and list all the points served by the new turbojet.

A few enterprising Aeroflot subdivisions are distributing "picturesque" timetables and promotion literature among the general population. The Chief Administration of the Civil Air Fleet, the agency issuing the advertising order, suggested that other Aeroflot subdivisions must adopt this "advanced" method of merchandising.

The Chief Administration told the Aeroflot management that the company's publicity and information program is far from satisfactory in view of the carrier's rapid growth. The agency added:

"At present, much of the money allocated for advertising and information is not being used. Some of the advertising sheets which are issued are poorly prepared and do not give the reader a clear impression of the benefits received by the Soviet people using air transport service.

"What is needed," the Chief Administration declared, "is for Aeroflot to make serious efforts to propagandize the advantages of air transportation. The population must be kept informed concerning the work of our airlines."

Along with the advertising, the Chief Administration called for the establishment of additional airline ticket offices in hotels, railroad stations, ship terminals and other strategic locations to

**SOVIET** sources credit the Tu-110 with a maximum speed of 620 mph.; a cruising speed of 500 mph. at 36,000 ft., and a maximum range of 2,000 mi. Engine design is officially credited to Lulko. Thrust is estimated at 14,500 lb.

**AEROFLOT** ad in recent issue of Ogonyok. Plane is Tu-104.

serve the public better. It complained that "owing to the negligence of Vnukovo Airport Director Zapylenov, plane tickets are sold at only five places in Moscow."

The switch in attitude toward advertising by the airline was preceded by the USSR Ministry of Trade criticism of Russian trade organization managers "who hold an incorrect notion regarding the objectives and tasks of commercial advertising."

In the opinion of these misinformed persons, the Trade Ministry asserted, commercial advertising is necessary only as a means of selling surplus commodities.

"If there are no surplus goods (or seats, in Aeroflot's case), then according to the opinion of these comrades, advertisements are entirely unnecessary. Such an attitude toward Soviet advertising is wrong."

For Aeroflot, the new Communist policy on advertising and promotion is fortunate and timely in view of its re-equipment program.

A few years ago, when the carrier's best equipment was obsolescent Il-12s, and Li-2s, when service was infrequent and fares were high, the airline had little to "propagandize." Now the prestige-building Tu-104s and the improved Il-14Ms coupled with promise of several new turboject and turboprop transports (AW July 22, p. 27) provide the airline with a substantial advertising message.

## REAL Buys 880s

**San Diego—REAL-Aerovias, Brazilian International Airline, has purchased four Convair 880 jet transports at a cost of over $17 million. It plans to place them in service from Buenos Aires to Chicago via Miami early in 1960.**

**REAL now operates the Chicago route with DC-4s and uses the Convair 340 and 440 on its routes in Brazil, Argentina and Paraguay. Delivery of the four jet transports is scheduled for late 1959.**

**The REAL order brings total 880 sales to 48.**

## Cities Will Be Ready For Jets, Douglas Says

**San Francisco**—Cities scheduled for the first commercial jet service generally will be ready for the jets when the time comes, Donald W. Douglas predicted in a recent address to the American Society of Newspaper Editors meeting here.

"I am convinced there has been an undue amount of concern about our readiness for the jet age," Douglas said. "Continuing improvement of our airports is a matter of national policy which usually receives strong support at the community level, and which, in general, is proceeding very well."

Extension of jet service to other than initial cities will come in a gradual and orderly manner, the Douglas Aircraft Co. president and board chairman told the editors. Most of the major terminals where transcontinental and intercontinental flights originate already have adequate runways to handle the DC-8, Douglas said. Airports with 7,000-9,000 ft. runways can generally be expected to handle the DC-8, and the longer runways in this range will be needed only for cities where the longest flights originate. These cities, Douglas said already have or soon will have runways that long or longer.

External noise may well be the greatest problem in preparing for jet operations, according to Douglas. But the problem is being given high priority by aircraft and engine manufacturers, he said, and jets will have sound suppressors when they go into operation.

Manufacturers are aware of the interrelationship of transport aircraft and all other facets of the air transportation system, Douglas pointed out, and "airplanes are not designed by dreamers in ivory towers." At all times the manufacturer must and does take into consideration the environment in which the aircraft must operate, Douglas added.

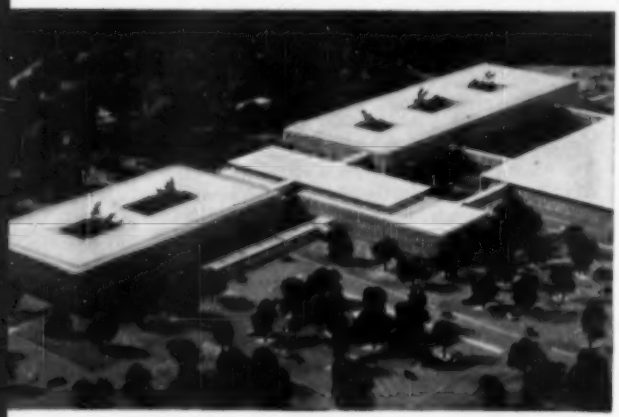
## Electra Engines Flown

**Los Angeles—Specially modified Super-Constellation fitted with four Allison 501 turboprop engines and Aeroproducts 606 four-bladed props, the combination planned for use on the Lockheed Electra transport, was test flown for first time at Burbank last week and put through a one hour flight schedule.**

**This was first time four Electra powerplants have been flown on a single aircraft.**

**Plane was an R7V-2 Navy bailment aircraft, and is scheduled for 1,000-hr. engine flight test program simulating airline scheduling.**

Dr. Dorothy M. Simon, Technical Assistant to the President of Avco Research and Advanced Development Division, addresses a colloquium of the Advisory Group for Aeronautical Research and Development (NATO) in Cambridge, England.



The Science Center for Avco's Research and Advanced Development Division, as seen in the architects' scale model, is now under construction in Wilmington, Massachusetts, a suburb 15 miles northwest of Boston's cultural hub. Scheduled for completion in early 1958, this ultramodern laboratory will house the scientific and technical staffs of the division.

---

Avco's new research division is now offering unusual and exciting career opportunities for exceptionally qualified and forward-looking scientists and engineers in such fields as:

**Science:**

**Aerodynamics • Electronics • Mathematics • Metallurgy**
**Physical Chemistry • Physics • Thermodynamics**

**Engineering:**

**Aeronautical • Applied Mechanics • Chemical • Electrical**
**Heat Transfer • Mechanical • Reliability • Flight Test**

*Write to Dr. R. W. Johnston, Scientific and Technical Relations, Avco Research and Advanced Development Division, 20 South Union Street, Lawrence, Massachusetts.*

# THE NEED TO KNOW

Man has long been motivated by the need to know—to know what lies beyond the oceans, the mountains and the sky; to know what elements make up the earth's crust and what forces control the universe. Many questions have been answered, but as our knowledge increases and the boundaries of our space expand, new questions are asked.

In the AVCO laboratories, exploratory work is under way in many fields of physics, physical chemistry, metallurgy, and engineering. Basic research and development are continuing in fields where we have already made contributions: high-speed aerodynamics, ICBM re-entry problems, physics and chemistry of air, heat transfer, electronic applications to advanced radar and computing, and high-temperature materials.

New ideas for future work are being discussed by the creative scientists and engineers who are members of this division. The scope of these new problems is so broad that the joint efforts of those from many disciplines are required for their solution. The future promises to be challenging.

A new research and development center, designed to give a proper physical environment and to provide the facilities and equipment needed, is under construction. The center is located near large universities to make available educational opportunities and wide professional contacts.

In the short period of our existence as a research and development division, much has been accomplished—problems have been solved and we have learned to work together. Now we are beginning to broaden the scope of our work and to add our contributions to the technical world, thereby strengthening the position of America and helping to satisfy man's need to know.

Dorothy M. Simon

Dr. Dorothy M. Simon
Technical Assistant to the President

**AVCO**
RESEARCH & ADVANCED DEVELOPMENT

**CIVIL AERONAUTICS ADMINISTRATION** is conducting high altitude tests of navigation aids with two B-57As on loan from the Air Force. Both aircraft have been painted in CAA official orange and white colors. Shown studying the results of one test recorded on airborne equipment are (left to right), CAA official Martin L. Sheppard, Administrator James Pyle and Bascom Lockett, chief, jet altitude flight inspection.

# CAA Tests Jet Age Navigation Aids

**Washington**—Civil Aeronautics Administration has begun a series of high-altitude flight tests to determine the effectiveness of air navigation aids in jet transport operations. Tests are being conducted with two B-57A turbojet bombers which have been converted into flying laboratories and borrowed from the Air Force.

Newly adopted program is designed to check the accuracy of jet airways and to test new or proposed facilities on a research and development basis. Developed by Arthur Jenks, CAA's chief of flight inspection, the program will augment CAA's present low-altitude flight test programs.

For the next year, the high-altitude flight inspection program will be devoted to identifying the problems associated with electronic air navigation at jet altitudes. New concepts of air traffic control also will be tested. On completion of the "problem identification" program, CAA will determine the degree to which navigation aids will be checked at high-altitudes in future flight inspection programs.

### Aircraft Position

The B-57s will conduct tests at altitudes between 20,000 and 50,000 ft.

To accurately establish aircraft position, two (or more) DME type signals obtained from Vortac or DME ground stations are used. To minimize position fix error that might arise if conventional airborne DME indicator were used, CAA employs Hewlett-Packard digital counters to measure transit time between transmission of pulse from airplane and receipt of reply from ground station to within one-tenth microsecond.

First tests with the Phillipsburg, Pa., Vortac demonstrated that the aircraft can be positioned accurately within plus or minus 500 ft. at 40,000 ft.

Consolidated Electrodynamics Corp. oscillographic recorders are used in B-57 to record digital counter readings (giving DME pulse transit time) as well as simultaneous readings of bearing signals from two (or more) Vortac ground stations. Data is recorded on 250 ft. roll of sensitized paper that moves at 10 in. per minute.

### Computer Use

Information gathered from each flight test is later fed into an International Business Machines Corp. 704 computer which performs triangulations required to establish airplane position from DME data. Computer also calculates corresponding airplane position from VOR or Tacan bearing data. Differences between the two represent errors in the VOR or Tacan bearing signals.

To insure maximum accuracy in establishing the aircraft fixes, the Coast and Geodetic Survey is resurveying the location of all CAA Vortac stations to determine their exact location in longitude, latitude and elevation.

Data obtained from the IBM computer gives aircraft's location at the time of each fix or reading within 1/100 of a second in azimuth and within 1/1,000 of a nautical mile in terms of ground distance.

Present CAA flight inspection programs consist of a basic program using DC-3s to check facilities between 700 and 10,000 ft. altitude and an intermediate program that employs Convair 440s to test facilities at altitudes between 10,000 and 20,000 ft.

According to CAA Administrator James Pyle, the high-altitude tests with the B-57s will supplement the basic and intermediate tests, which he says are too slow a system and not sufficiently accurate for jet operations. Pyle added that the B-57s will permit testing under all weather conditions and will enable the CAA to reach sufficiently high altitudes to learn whether the efficiency of the navigation aids decreases as altitude increases.

## Darkness, Weather Blamed in Crash

**Washington**—Darkness and adverse weather conditions in which the pilot could not maintain control of the aircraft was listed by the Civil Aeronautics Board last week as the probable cause of an Alaska Airlines plane crash near Nome last Oct. 2. Five occupants of the aircraft, a Stinson AT-19, were killed.

The CAB said it is believed the pilot, without instrument training, completely lost visual contact in a snowstorm, lost control and struck the ground in a steep spiral. The flight was en route from Council to Nome and crashed 15 miles from its destination, the CAB said.

The board added that operations specifications of the air carrier restricted its operation over this route to day only, but that it was probable that total darkness existed at the time of the crash.

# Lake Central to Launch Big Expansion

By L. L. Doty

**Washington**—Lake Central Airlines is launching a fullscale route expansion and refinancing program that it has had to postpone for more than two years while it waited for a final verdict on the long drawn-out question of merger with North Central Airlines.

With Civil Aeronautics Board disapproval of the proposed merger last month (AW July 15, p. 25), Lake Central has been freed of what the CAB bureau counsel once called the "hampering effect of the pending acquisition." The CAB decision also virtually places ownership of the airline in the hands of company employes and officers as a result of a stock-purchase option which was exercised in 1955, but was subject to the prior rights of North Central.

### Reshaped System

If the company's route development program materializes, the entire system—now embracing 31 cities in the Great Lakes region between Indiana and western New York—may be reshaped to change traffic flow from a generally East-West to a North-South direction. The program also may introduce to the local service industry the "area concept" of airline operations, a certificate exemption that will grant Lake Central greater flexibility in establishing a service pattern within its area.

Meanwhile, in a major move to strengthen its shaky financial structure, the airline has taken its first step in a long-range refinancing program. It has filed with the Securities and Exchange Commission a prospectus for the issuance of $300,000 in convertible subordinated debentures at 6%. Later plans include bank loans totaling $500,000 to be secured by chattel mortgages on aircraft and the completion of a long-term note agreement for an unsecured loan of $200,000.

Lake Central officials expect the debentures will be purchased by the employe-owners, precluding a public offering. The offering will be made through the company's officers and directors without an underwriter. About $200,000 of the $300,000 will be used to retire outstanding accounts payable and the balance will be used to improve the airline's cash position.

Funds from the debenture sale will provide a significant boost to Lake Central's financial structure, which showed current assets of $479,000 as of March 31, compared to current liabilities of $919,000. The additional capital also will give further impetus to a remarkable traffic growth pattern that brought a total of 135,720 passengers in 1956 compared to 12,757 in 1950, the year following the airline's organization. In the same period, the company's passenger load factor has climbed consistently each year from 16% to 43% and revenue-miles flown has jumped 1 million in 1950 to 2.3 million in 1956.

### Contract Delayed Recapitalization

That no corrective steps had been taken earlier to adjust the substantially under-financed and under-capitalized condition of the company to coincide with the sharp rise in passenger traffic can be attributed chiefly to the 1952 contract between the original owners and North Central Airlines for the sale of 97% of the outstanding common stock to North Central. Stockholdings at that time were deposited under a voting trust pending CAB approval of the sale. Lake Central was legally prohibited from issuing any securities which would alter the equity or voting rights of the stock.

But in 1954, the stockholders who had offered the stock to North Central gave the Lake Central officers and employes an option to purchase the stock subject to the rights of North Central. The option was exercised in January, 1955.

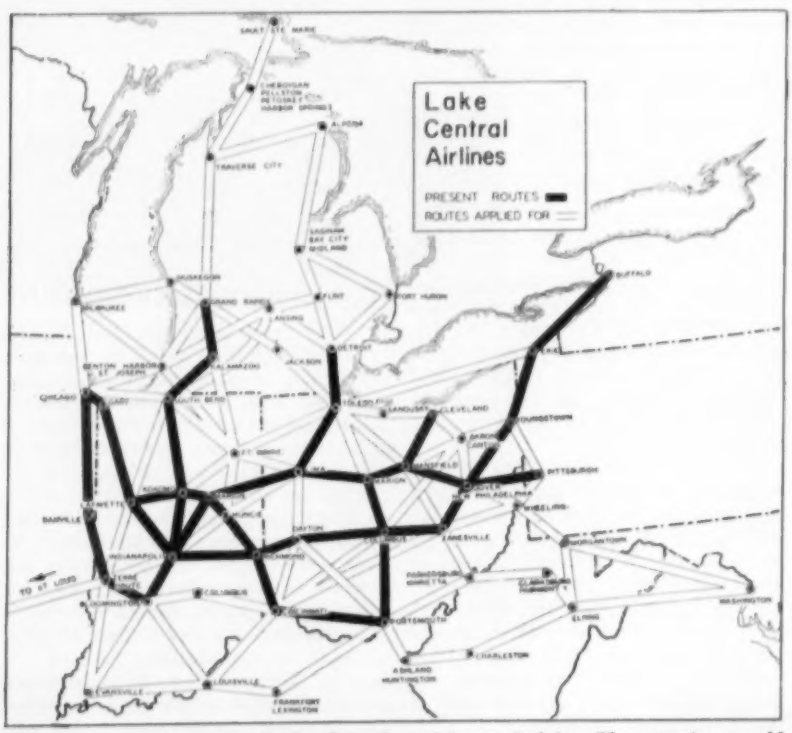
Decision by the CAB disapproving the acquisition of Lake Central by North Central voided the 1952 contract and gives ownership to the Lake Central employes and officers, subject to any available legal recourse taken. CAB's decision is final unless a petition for reconsideration is filed within 30 days or an appeal to the Circuit Court of Appeals is filed within 60 days following the decision.

Significance of the ruling is underscored in a statement by CAB examiner Paul N. Pfeiffer in his initial recommendation opposing the merger. "It is apparent that whichever group is eventually successful in acquiring control of Lake Central, it will in all probability obtain an excellent bargain for the price paid," Pfeiffer said.

About 150 of the 385 employes are stockholders and no individual owns more than 5% of the shares outstanding.

Stock is held under a voting trust contract which will be terminated upon final determination that the original 1952 contract is void and subject to no further legal recourse.

Gwin Hicks, Lake Central president, told AVIATION WEEK that the "long




**MAP** shows present routes and what Lake Central has applied for. The extensions would take the airline into Washington, Louisville, Ky., St. Louis, Mo., and Milwaukee, Wis.

period of uncertainty" over the merger with North Central has been a strong deterring factor in the development of Lake Central he said it "nevertheless gave us a breathing spell in which to develop a detailed, comprehensive program."

Hicks pointed out that the airline has never had a route system of its own but has always operated over a disjointed series of segments that have been cast off by the trunkline carriers. Present route structure fails to conform with the true feeder-line principle since it does not permit a normal flow of traffic from smaller communities to major traffic hubs, he said.

### Structure Significance

The feeder-line structure will be of more significance later when operations of the long-range jet transports are confined to the major traffic areas, Hicks said.

He tied in the route structure to the local service re-equipment problems by saying the traveling public will resist flying to or from these "jet hubs" in an unpressurized aircraft manufactured 20 years ago.

Hicks wants the route structure revised to give greater stress on North-South operations between the Great Lakes and Ohio River cities throughout the area Lake Central serves in Indiana, Ohio, Michigan, Illinois, Pennsylvania and New York. In this way, he hopes to establish "arterial lifelines" that will be non-competitive with the trunk airlines but will strengthen Lake Central economically with heavier traffic.

Furthermore, Hicks reasons that the Great Lakes-St. Lawrence Seaway will eventually cause a sharp economic readjustment in the economic structure of the Midwest and will establish such Great Lakes cities as Saginaw, Toledo, Sandusky, Cleveland and Buffalo as major ports, causing a diversion of traffic from eastern seaboard ports.

That he may win at least some of the routes he seeks is implicit in the wording of the recent CAB decision. The Board found that prospects for Lake Central's future as an independent carrier are "more favorable than pictured by the examiner," who earlier had recommended the merger with North Central.

### Pending Proceedings

In addition, the Board stated that pending local service proceedings—presumably the Great Lakes Local Service Case—were better "vehicles" for strengthening the airline than the proposed merger.

Hicks said he is avoiding paralleling trunkline routes wherever possible in planning his route structure. He pointed out that he discussed his plans with the managements and economic researchers of airlines operating through the Lake Central areas before applying to the CAB for any routes. Consequently, he does not anticipate protests from the trunklines when hearings in the Great Lakes Local Service Case are resumed here.

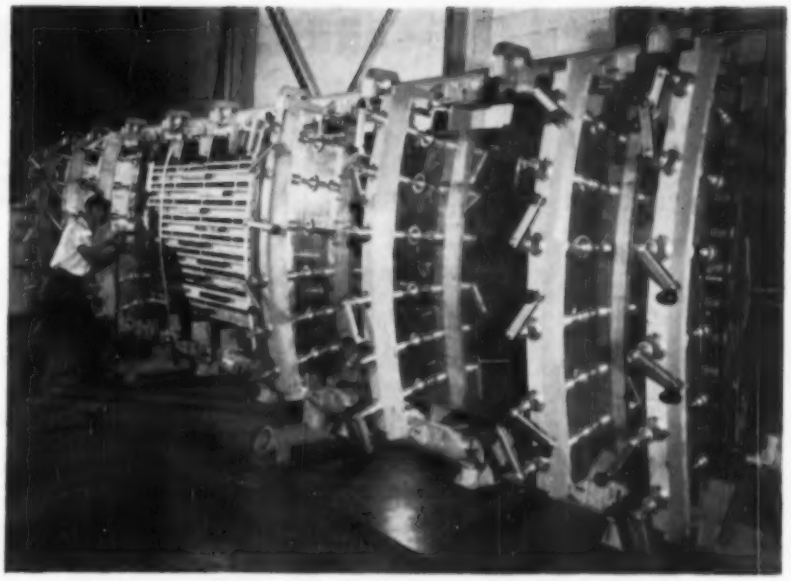
Each city involved in the route applications was consulted and provided with a detailed analysis of his proposals.

Hicks also confirmed his findings with utility companies, particularly the telephone companies in the areas under consideration, to make certain that his long-range planning conformed with the thinking of other forecasters.

Lake Central operates a fleet of 10 DC-3s over 1,509 miles of routes. Gross revenues were $2,784,963 in 1956 compared to $2,598,046 in 1955 and $2,301,491 in 1954. In 1956, the airline showed an operating income of $4,142 and a net loss of $30,939.

The airline reopened its mail rate case as of Jan. 1, 1957 and has been operating under a temporary rate since then. Federal subsidy during the first quarter of 1957 was $359,531 and total operating revenues were $719,835.

Headquarters of Lake Central are at Weir County Airport, Indianapolis. Recently the airline consolidated its maintenance and general offices facilities under one roof after operating at 13 different locations on the airport since the airline was organized in 1949. The move has cut costs by 5 cents on airplane miles.



## F-27 Wing in Production

**Production of the Fairchild F-27 is under way at the Fairchild Aircraft Div. plant at Hagerstown, Md. Here skin is tack riveted to stringers on the wing center section upper panel prior to redux bonding. More than 80 orders and options have been placed.**

## Airport Nuisance Suit Lost by Plaintiffs

**Los Angeles**—Noise and nuisance suit by 35 families living near Van Nuys has been won by the City of Los Angeles, defendant in the case. Damages were denied the plaintiffs, who totaled 71 individuals, and the Superior Court Judge also ruled that the city was entitled to recover costs of the suit from the plaintiffs.

The city contended that the airport was founded prior to the time that any of the plaintiffs acquired property in the vicinity. It also denied any authority over the movements of aircraft in the air, a control responsibility of the Federal government.

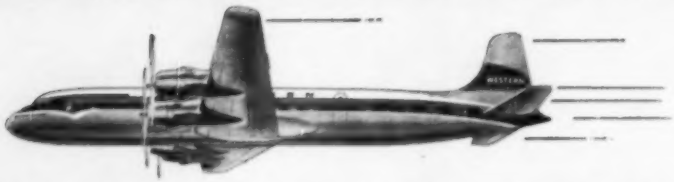
The case was known as Carl G. Attman and Isabelle L. Attman, et al, versus the City of Los Angeles.

## SHORTLINES

► **American Airlines** will begin Douglas DC-7 nonstop service between St. Louis and New York on Aug. 11; and will begin transcontinental Douglas DC-6 aircoach service from New York to Cincinnati, St. Louis and Los Angeles on Aug. 18. Under the new DC-7 schedule, American will offer 24 nonstop flights weekly between St. Louis and New York.

► **United Airlines** has signed interline traffic agreement with three foreign air-

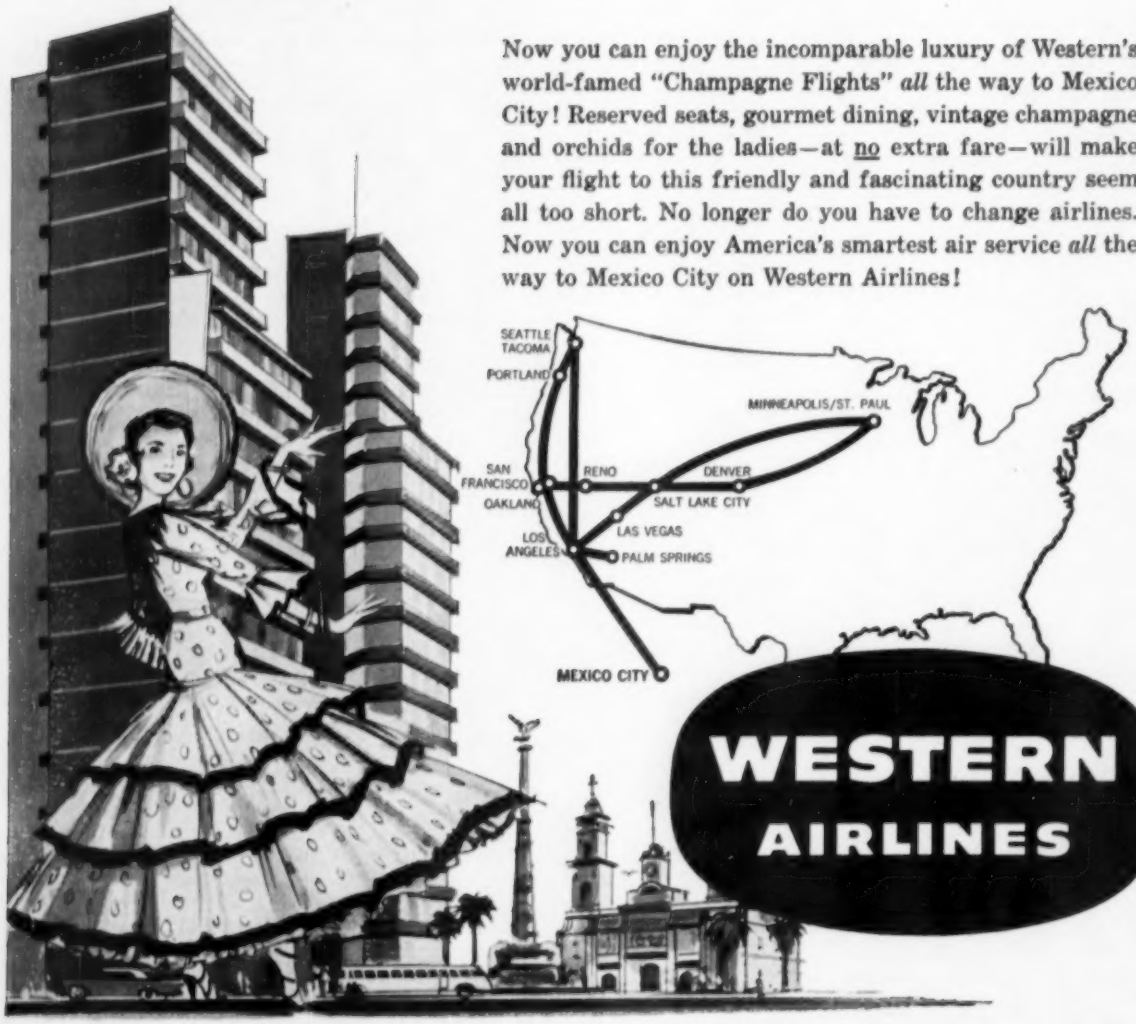
**NOW! THRU ONE-CARRIER SERVICE FROM ALL THE WEST!**



## WESTERN AIRLINES

# Champagne Flights to MEXICO CITY

Now you can enjoy the incomparable luxury of Western's world-famed "Champagne Flights" *all* the way to Mexico City! Reserved seats, gourmet dining, vintage champagne and orchids for the ladies—at no extra fare—will make your flight to this friendly and fascinating country seem all too short. No longer do you have to change airlines. Now you can enjoy America's smartest air service *all* the way to Mexico City on Western Airlines!



lines operating over transatlantic, European and Latin American routes. The carriers are Icelandic Airlines, operating between New York and Iceland; Derby Aviation, Ltd., routing only in Europe; and Transportes Aereos Nacionales, flying between Miami and Central and South American points. Agreements will allow for passenger and air cargo transportation on United's routes and each of the other airlines by issuance of a single ticket or air waybill.

► **Ozark Air Lines** flew 270,343 lb. of air freight during June, nearly doubling the June, 1956 figure of 137,866 lb.

► **Air France** will begin Lockheed 1649 Constellation service between New York and Paris on Aug. 18. The flight, leaving New York on Sundays, offers both first class and tourist seating. Air France began operation of its "Golden Parisian" service, using the 1649, on Aug. 2. These luxury flights offer private compartments with bed facilities and are limited to 32 passengers.

► **Varig Airlines** of Brazil flew 515,414 passengers during 1956. The airline reported this was a 21% increase over the previous year. Other figures for 1956 are: passenger-miles, 213,369,603; cargo, 44,973,025 lb. and foreign and domestic mail, 680,291 lb.

► **Northeast Airlines** carried 43,363 passengers between July 1 to July 15 as opposed to 31,133 in the same period last year. The carrier announced that load factors on some Boston-New York-Miami flights run as high as 93%.

► **Lufthansa and Air France** have signed an air agreement whereby each carrier will be represented by the other, in areas mainly served by the other. This means Lufthansa will be general agent for Air France in West Germany and West Berlin and Air France will be general agent for Lufthansa in France, North Africa, French West and Central Africa and in Asia. New agreement will not affect either carrier's offices in France and Germany.

► **Riddle Airlines** is flying 200 small cars to dealers throughout Florida. To facilitate quick deliveries of BMW Isetta 300s, a Florida distributor decided to ship the autos by Riddle to meet demands by Florida dealers.

► **Northwest Airlines** began operating radar-equipped Douglas DC-7Cs on all its daily flights over the North Pacific to and from Tokyo, Okinawa and Manila. Northwest has been using a combination of Lockheed Super-G Constellations and DC-7Cs since April.

# AIRLINE OBSERVER

► **Watch for an early announcement by British European Airways on the purchase of jet transports. Strongest possibility appears to be the de Havilland Comet 4B to be used as an "interim" type to compete with the Sud Caravelle on European routes. BEA also is interested in the four-engine turbojet Bristol 200 (AW May 27, p. 41) for the 1962-3 period to compete with the larger and faster designs expected to be in operation at that time.**

► Civil Aeronautics Administration reports a 16% increase in the number of aircraft operated by U. S. scheduled airlines during 1956. Airlines operated 1,497 aircraft as of January, 1956 compared to 1,735 planes as of January, 1957. For the first time, the number of four-engine transports exceeded the number of twin-engine planes, although DC-3s continued to be the most numerous of all models, representing more than one-fifth of the total U. S. fleet.

► **Chances of Congress taking final action on pending aviation bills this session are felt by some observers to be slim because of the civil rights debate. But backers of such measures as capital gains, equipment trust and guaranteed loans still are hopeful that the slight congressional opposition to these bills will ease the way for approval before Congress adjourns.**

► Pan American World Airways has been allotted a $53,509,304 contract by the Air Force for further work on the Air Force Missile Test Center at Patrick Air Force Base, Fla. Arrangement with Pan American for operation and management of the test range dates from late 1953.

► **Capital Airlines last week won an appeal before the arbitration panel of the Air Traffic Conference that it had not violated rules pertaining to the entertainment of travel agents. It was the first time any airline has refused to accept a ruling and pay a fine of ATC's enforcement office. ATC regulations prohibit open houses or planned parties at travel agent conventions although there are no restrictions on informal entertainment of agents in hotel rooms. The arbitration panel agreed with Capital that its entertainment fell into this category at a convention of the American Society of Travel Agents in Chicago last November.**

► Scandinavian Airlines System is expected to be granted traffic rights at Winnipeg on the carrier's transpolar route between Los Angeles and Copenhagen. SAS presently operates into Winnipeg for refueling only. Similar rights are expected to be given to Canadian Pacific Airlines at Edmonton on its route between Vancouver and Amsterdam. Canadian government will examine this fall applications of airlines flying the transpolar routes and seeking rights to handle passenger traffic in Canada.

► **Air Line Pilots Assn. and the Civil Aeronautics Administration have taken opposite views on whether the Civil Aeronautics Board's decision to revoke the transport rating of Trans World Airlines pilot Leonard Specht has clarified pilots' emergency authority (AW July 29, p. 43). CAA claims the Board's unprecedented action does clarify the issue. ALPA feels the decision puts the issue even further in doubt. Both sides will wait for the Board's written opinion before taking any action.**

► Bonanza Air Lines recently ran afoul of a new navigational hazard at Kingman Airport, Ariz.—the local Little Leagues baseball team. The boys, seeking telephone poles for lights to illuminate night games, were given permission to scout the airport for any poles not in use. Later, when the Bonanza-owned "H" marker was reported inoperative by pilots, company technicians discovered that the set was in working order but that the five poles supporting the antenna had been neatly sawed off.

► **Howard Hughes has placed a contract for 33 Boeing 707 jet transports it was revealed in a prospectus recently filed with the Securities and Exchange Commission in connection with a Trans World Airlines stock issue (AW July 22, p. 47). The prospectus said TWA had made no commitment to purchase the planes from Hughes.**

# *New Cessna YH-41 delivers top performance plus big maintenance savings to helicopter flying!*

Cessna's all-new YH-41, recently purchased by the U. S. Army for its air arm, combines the latest in design and engineering advances to give operating and maintenance performance never before experienced in the helicopter field!

For example, the engine—mounted in the nose of the fuselage—makes installation and servicing easy—provides extra cargo or passenger space. Cessna has made the rotor assembly aerodynamically clean. Also, the drive system on the new YH-41 is a masterpiece of simplicity, has a minimum of parts—conveniently located for easy servicing.

Offering multi-utility uses, the 4-place YH-41, at 3,000 lbs. gross weight, can climb higher, faster than any other helicopter in its class—sea level to 10,000 ft. in less than 12 minutes! Its speed is the fastest in the light helicopter field.

CESSNA AIRCRAFT CO., WICHITA, KANSAS

# Airline Income and Expenses — May, 1957

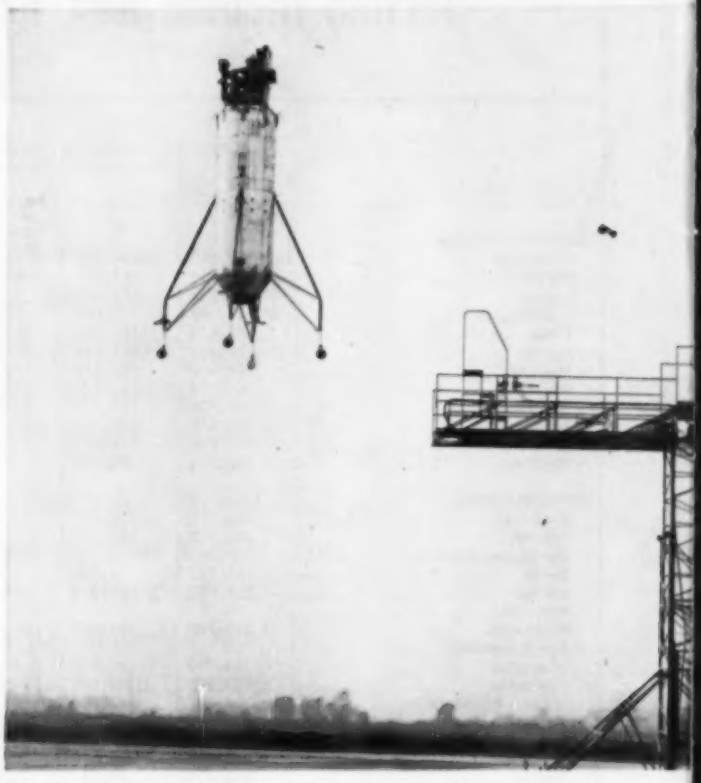
(In Dollars)

| | Passenger Revenue | Mail Revenue | Express Revenue | Freight Revenue | Total Operating Revenue | Total Operating Expenses | Net Operating Income (before taxes) |
|---|---|---|---|---|---|---|---|
| **DOMESTIC TRUNK** | | | | | | | |
| American | $23,113,193 | $609,590 | $189,117 | $1,619,898 | $25,999,954 | $24,025,116 | $1,974,838 |
| Braniff | 4,195,596 | 117,630 | 24,683 | 138,759 | 4,351,649 | 4,198,679 | 352,970 |
| Capital | 7,864,964 | 174,382 | 40,623 | 164,179 | 8,314,901 | 7,836,384 | 478,517 |
| Continental | 2,002,015 | 41,895 | 11,944 | 45,607 | 2,137,873 | 1,960,854 | 177,018 |
| Delta | 5,878,875 | 131,293 | 41,600 | 239,272 | 6,433,208 | 5,951,020 | 482,188 |
| Eastern | 19,422,580 | 432,746 | 891,474** | ..... | 20,816,491 | 21,283,742 | −336,275 |
| National† | 3,696,190 | 82,360 | 20,301 | 149,294 | 4,118,939 | 4,102,689 | 16,250 |
| Northeast | 3,643,258 | 62,726 | 35,732 | 93,638 | 4,835,394 | 6,141,107 | −1,305,713 |
| Northwest | 4,059,726 | 157,094 | 357,294** | ..... | 4,620,989 | 4,657,767 | −36,777 |
| Trans World | 14,374,450 | 378,874 | 888,999** | ..... | 16,103,743 | 15,948,954 | 154,789 |
| United | 20,328,724 | 810,608 | 149,408 | 1,175,887 | 22,673,297 | 21,901,795 | 777,302 |
| Western | 3,027,071 | 84,718 | 25,297 | 87,235 | 3,289,797 | 2,985,966 | 303,831 |
| **INTERNATIONAL** | | | | | | | |
| American | 360,312 | 6,062 | 127 | 64,235 | 453,399 | 479,416 | −26,017 |
| Braniff | 574,397 | 102,257 | ..... | 31,998 | 719,815 | 651,060 | 68,754 |
| Caribbean-Atlantic | 141,582 | 2,422 | 5,916** | ..... | 160,634 | 136,231 | 24,403 |
| Delta | 491,752 | 4,540 | ..... | 16,412 | 535,185 | 477,420 | 57,765 |
| Eastern | 1,239,723 | 31,210 | 32,186** | ..... | 1,366,424 | 1,215,394 | 151,692 |
| National† | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Northwest | 1,548,789 | 492,605 | 300,766** | ..... | 2,421,039 | 2,066,076 | 394,963 |
| Pan American | | | | | | | |
| Alaska | 388,000 | 21,000 | 65,000** | ..... | 498,000 | 691,000 | −193,000 |
| Atlantic | 9,525,000 | 599,000 | 748,000** | ..... | 12,130,000 | 10,693,000 | 1,437,000 |
| Latin American | 5,387,000 | 193,000 | 1,196,000** | ..... | 7,412,000 | 7,952,000 | −540,000 |
| Pacific | 4,521,000 | 444,000 | 612,000** | ..... | 6,655,000 | 6,655,000 | ..... |
| Panagra | 1,157,000 | 42,000 | ..... | 150,000 | 1,588,000 | 1,619,000 | −31,000 |
| Trans World | 4,232,380 | 440,478 | 386,773** | ..... | 5,418,124 | 4,961,365 | 456,759 |
| United | 908,675 | 34,911 | ..... | 19,254 | 984,491 | 907,326 | 77,165 |
| **LOCAL SERVICE** | | | | | | | |
| Allegheny | 449,353 | 7,513 | 6,768 | 14,950 | 660,680 | 657,922 | 2,758 |
| Bonanza | 148,109 | 2,590 | 1,305 | 5,165 | 267,610 | 276,554 | −8,750 |
| Central | 131,722 | 3,302 | 754 | 4,638 | 336,073 | 337,501 | −1,428 |
| Frontier | 268,880 | 222,773 | 2,345 | 24,660 | 533,268 | 557,041 | −25,788 |
| Lake Central* | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Mohawk* | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| North Central | 618,290 | 19,439 | 8,335 | ..... | 802,738 | 883,710 | −85,060 |
| Ozark | 381,217 | 236,568 | 5,758 | 13,912 | 643,432 | 655,001 | −20,735 |
| Piedmont | 477,251 | 9,586 | 2,894 | 10,741 | 733,006 | 718,500 | 14,906 |
| Southern | 200,349 | 9,343 | 3,314 | ..... | 371,182 | 380,979 | −9,797 |
| Southwest | 309,303 | 10,096 | 2,937 | 4,268 | 464,554 | 504,354 | −39,800 |
| Trans-Texas | 286,579 | 10,419 | 2,713 | 12,021 | 569,437 | 566,008 | 13,345 |
| West Coast | 218,055 | 4,537 | 1,537 | 4,312 | 375,364 | 363,161 | 12,203 |
| **HAWAIIAN** | | | | | | | |
| Hawaiian | 340,075 | 3,696 | ..... | 36,698 | 434,101 | 450,359 | −16,258 |
| Trans-Pacific | 169,084 | 1,169 | 10,945** | ..... | 187,062 | 201,396 | −14,334 |
| **CARGO LINES** | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Aerovias Sud-Americana | ..... | ..... | ..... | ..... | 175,654 | 179,486 | −3,831 |
| Flying Tiger | ..... | 12,534 | 857,701** | ..... | 2,926,963 | 2,742,599 | 184,364 |
| Riddle | ..... | 12,244 | 569,085** | ..... | 798,561 | 725,463 | 73,078 |
| Seaboard & Western | ..... | ..... | ..... | ..... | 9,557,021 | 8,561,826 | 995,194 |
| Slick | ..... | ..... | ..... | ..... | 1,905,258 | 2,204,380 | −299,122 |
| **HELICOPTER** | | | | | | | |
| Chicago Helicopter | 12,044 | 71,820 | 485** | ..... | 84,349 | 96,081 | −15,059 |
| Los Angeles Airways | 15,708 | 12,324 | 4,857 | ..... | 114,403 | 91,110 | 22,432 |
| New York Airways | 53,186 | 5,810 | 2,038 | 3,714 | 177,988 | 288,975 | −50,987 |
| **ALASKAN** | | | | | | | |
| Alaska Airlines | 139,762 | 47,972 | 916 | 81,470 | 469,000 | 474,796 | −5,796 |
| Alaska Coastal* | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Cordova | 11,268 | 24,685 | ..... | 6,750 | 170,644 | 159,428 | −11,216 |
| Ellis | 47,119 | 4,842 | ..... | 5,635 | 92,450 | 82,622 | 9,827 |
| Pacific Northern | 534,622 | 56,842 | 88,161** | ..... | 771,962 | 751,309 | 20,653 |

* Not available  ** Property figure  † System figure

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

**FIRST** vehicle, C.400 P.1 tethered under gantry, is flown by remote control from ground.



**ATAR VOLANT** C.400 P.2 in the air near its maintenance platform. Altitude reached during the current program has been about 700 ft.

# Flying Atar VTOL Is Simple, Promising

**AUGUSTE MOREL,** Flying Atar test pilot seated at controls, his left hand on power lever, his right on a tiny control stick mounted on a pylon.

By David A. Anderton

**Paris**—Snecma's Atar Volant, a simple VTOL test vehicle consisting of one Atar turbojet, an ejection seat and four outriggers, was the technical sensation of the 22nd Salon de l'Aeronautique.

Flown before an open-mouthed crowd by Auguste Morel, veteran French test pilot and ex-naval flier, the "Flying Atar" roared upward to a height near 500 ft., slid easily through the sky to a point in front of the reviewing stands, maneuvered gently and then returned to its parking area across the field where it settled in a cloud of reddish dust blasted loose by its exhaust jet.

In those brief minutes of the demonstration, Snecma's five-year development program with the odd vehicle showed tangible proof of the engineering feasibility of such a design. The piloted Atar test vehicle, designated C.400 P.2, is one of the stages in a multi-step program begun by the French company in 1952. Next step is the P.3, similar in layout, but with an enclosed cabin and a rotating seat to check the characteristics of transition from vertical to horizontal flight.

So far, a total of about $4 million has been spent on the project, divided about evenly between company funds and French Air Ministry backing. Average engineering force on the project has been 15 men headed originally by Hermann Oestrich, technical manager.

### Simplest Concept

In its present configuration, the Flying Atar is certainly the simplest VTOL now flying. It consists of a standard Atar D turbojet rated at 2,900 kg. (about 6,400 lb.) modified to operate vertically, a light cylindrical housing containing fuel and controls, four outriggers which are the landing gear and which also support four bleed air jets for roll control, the necessary pilot's controls and a low-altitude ejection seat built by Sud Aviation.

Takeoff weight of the complete vehicle is 2,600 kg. (about 5,740 lb.)

of which almost one-fifth is fuel. Even so, safe flight duration is limited to a little more than four minutes.

Heart of the system is the pneumatic thrust deviator developed by Snecma. This is the principle also known as the "air nozzle" because it uses air injected at right angles to the main exhaust stream to deflect that stream locally to form a nozzle. Normally this is used in a complete ring around the exhaust jet so that the deflection produces an axially symmetric nozzle. But for the Flying Atar, the bleed jet—using hot air taken from the combustion chamber casing—is separated into four quadrants which can be operated singly or in combination to produce an unsymmetrical deformation of the jet.

Such dissymmetry produces an inclined thrust vector which pitches the Atar from its vertical flight path and starts the transitional motion of the vehicle.

### In Equilibrium

Once the motion has been started and the vehicle is tilted from the vertical, it is in equilibrium and will continue to move in a horizontal direction until the controls are reversed and the thrust axis is tilted in the opposing direction.

Roll control is obtained by paired jets using air bled from the front of the engine compressor. These jets are supported on the outrigger landing gear and discharge just outboard of the outriggers.

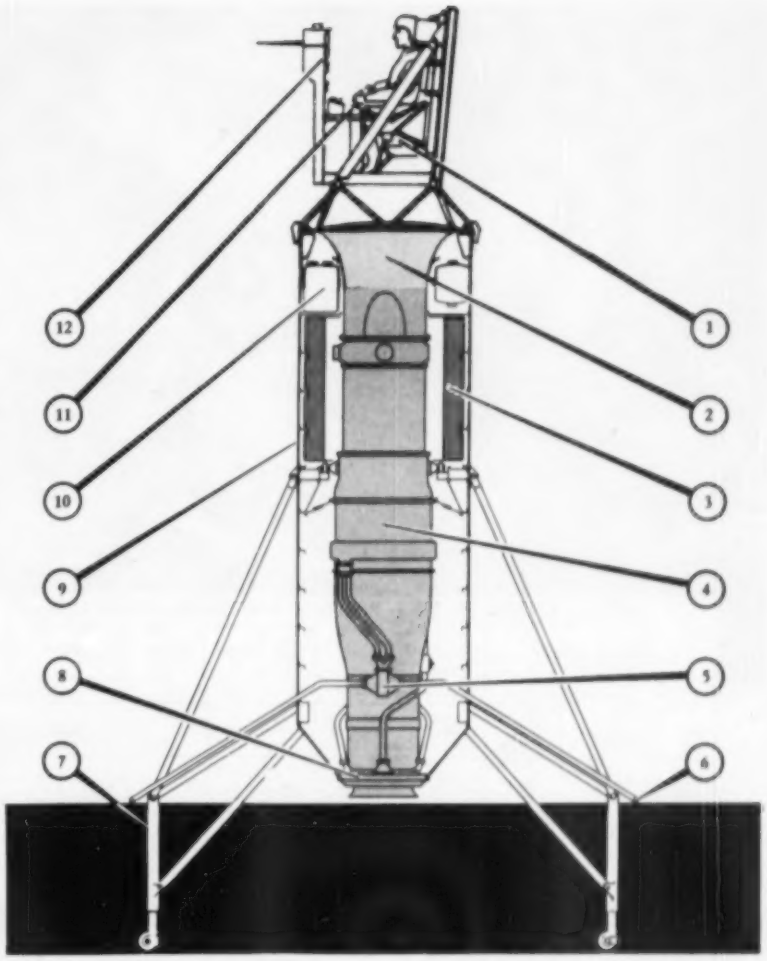
Stabilization of the Flying Atar is performed by an autopilot using signals from a combined system of attitude and rate gyros. The first measure the vehicle's attitude and the second its deflection rate.

Overall height of the P.2 is about 23 ft. The complete nacelle is approximately 20 ft. high and just under five feet in diameter.

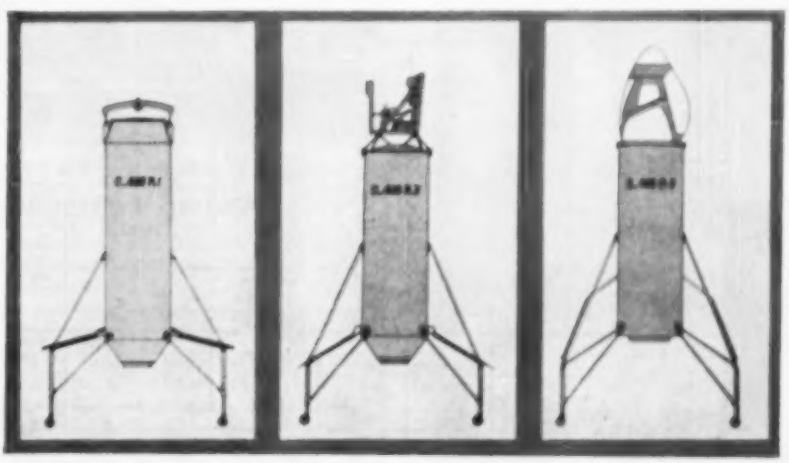
The pilot sits in the low-altitude ejection seat manufactured by Sud Aviation. He faces an array of flight instruments mounted in the shape of the Greek letter Pi. At his left is a conventional power lever and between his knees is a pylon mounting a tiny control stick on the top. This stick operates the electrical signal system that controls the jet deflection.

Because of the low thrust-weight ratio of the Atar Volant—approximately 1.1 at takeoff and increasing during flight as fuel is burned to a maximum approaching 1.4—control of the vehicle is a sensitive procedure and requires a light hand on the throttle. Coupled with this is the added sensitivity of the vehicle in response because damping and drag are both very low.

A further complication in flying the Atar is that as the angle of inclination increases, the vertical component of the




**SECTION** through Atar C.400 P.2 shows design features of the unusual VTOL craft: (1) Sud Aviation ejection seat; (2) screened bellmouth inlet for engines; (3) fuel tanks with a capacity of 179 gal.; (4) Atar DV turbojet; (5) mixing valve for roll control jets; (6) roll control jets; (7) outrigger landing gear; (8) air nozzle for thrust deviation; (9) nacelle structure; (10) stabilization system; (11) pilot's controls; (12) instrument yoke.



**PROGRESSIVE** steps in the test program: C.400 P.1 (left), unmanned radio-controlled vehicle; P.2 (center), manned machine currently flying; P.3 (right), basically the same as other units but with a gimbal-mounted seat and controls, enclosed cabin.

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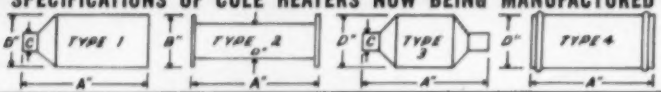


| CAT. NO. | CAPACITY K.W. | VOLTAGE | RATED AIRFLOW LBS./MIN. | TEMP. RISE AT RATED AIRFLOW °F. | THERMAL LIMITER | TYPE | DIMENSIONS A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|---|
| C-970 | .6 | 27 | 1.7 | 82 | Thermo./Link | 4 | 6 | | | 2 |
| C-672 | .75/.37 | 27 | 5 | 34/17 | Thermostat | 4 | 8½ | | | 3 |
| C-1122 | 1 | 115 | 15 | 15 | Fusible Link | Blower | 1¼ | | | 3¾ |
| C-665 | 1./.67/.33 | 27 | 5 | 46/31/15 | Thermostat | 3 | 8⅝ | | | 3½ |
| C-553 | 2 | 27 | 6 | 77 | Thermostat | 3 | 9 | | 1 | 2 |
| B-1246 | 2 | 27 | 10 | 47 | Thermo./Link | 4 | 6⅞ | | | 1½ |
| C-667 | 2/1.3/.7 | 115 | 3 | 155/115/54 | Fusible Link | 2 | 6½ | | | 3 |
| C-883 | 2 | 27 | 6 | 76 | Thermo./Link | 4 | 6 | | | 2 |
| C-990 | 2 | 27 | 6 | 76 | Thermo./Link | 4 | 6 | | | 2 |
| C-995 | 2 | 27 | 7.5 | 62 | Fusible Link | 2 | 2½ | 8 | | 6-9/16 |
| C-1258 | 2/4 | 27 | 2 | 230/460 | Thermostat | 2 | 10-3/16 | 6 | | 5 |
| C-660 | 2 | 115 | 11 | 42 | Thermostat | 4 | 7 | | | 3 |
| C-726 | 2.1/1.05/.55 | 27 | 4 | 123/61/30 | Thermostat | 4 | 9½ | | | 3 |
| C-1079 | 3 | 115/200 | 3 | 230 | Thermostat | 2 | 13 | 3⅛ | | 3½ |
| D-611 | 3 | 115/200 | 22 | 30 | Thermostat | Misc. | 25 | | | 7 |
| C-561 | 3 | 115 | 3 | 235 | Fusible Link | 4 | 13 | | | 3½ |
| C-666 | 3/2/1 | 27 | 10 | 70/47/23 | Thermostat | 4 | 10¼ | | | 3½ |
| C-1329 | 3.5 | 115/200 | 40 | 20 | Thermostat | 2 (Blower) | 13⅝ | 6-1/16 | | 5 |
| C-885 | 4 | 27 | 14 | 66 | Thermo./Link | 1 | 8½ | | 2 | 4 |
| C-980 | 4 | 27 | 6 | 155 | Thermo./Link | 4 | 9-15/16 | | | 2 |
| D-312 | 4 | 27 | 10 | 94 | Thermostat | 1 | 8½ | | 2 | 4 |
| C-932 | 5/2.5 | 27 | 15 | 70/35 | Fusible Link | 4 | 9½ | | | 4 |
| C-1082 | 5 | 115/200 | 15 | 70 | Thermostat | 4 | 15⅜ | | | 4 |
| D-553 | 5/10/15 | 115/200 | 130 | 8/16/24 | Thermostat | 2 (Misc.) | 20 | 6¾ | | 6 |
| C-562 | 5 | 115 | 15 | 70 | Fusible Link | 4 | 15⅜ | | | 4 |
| C-602 | 6 | 27 | 10 | 140 | Thermo./Link | 4 | 11¼ | | | 4 |
| B-1413 | 6 | 27 | 13 | 108 | Fusible Link | 2 | 5¼ | | | 3 |
| C-747 | 6/3 | 27 | 15 | 94/47 | Fusible Link | 2 | 6⅝ | | | 4 |
| C-662 | 7 | 27 | 15 | 108 | Fusible Link | 4 | 9½ | | | 3 |
| C-671 | 7/3.5 | 27 | 50 | 32/16 | Fusible Link | 4 | 9½ | | | 3½ |
| C-787 | 7/3.5 | 27 | 8 | 205/102 | Thermo./Link | 4 | 9½ | | | 3½ |
| C-1329 | 7.5 | 115/200 | 18 | 96 | Thermostat | 2 (Blower) | 14½ | 8⅞ | | 7¾ |
| C-607 | 9 | 115 | 4 | 525 | Fusible Link | 4 | 15 | | | 4 |
| C-648 | 9 | 115 | 8.33 | 255 | Thermostat | 4 | 15 | | | 4 |
| | | | | | | | **Length** | **Width** | | **Height** |
| A-7385 | .05 | 27 | Conduction | 920°F | — | Flat | 1½ | 1.7 | | ⅝ |
| A-6645 | .058 | 27 | Conduction | 920°F (60W/IN²) | — | Tube | 3 | | | ½ |
| A-6649 | 12 | 27 | Conduction | 1000°F | — | Flat | 2¾ | 2 | | ⅜ |
| D-608 | 1.15 | 115 | Conduction | 170 | Thermostat | Water | 13½ | | | |
| C-1319 | 3 | 115/200 | 22 | 30 | Thermostat | Misc. | 27 | 11⅞ | | 6 |
| C-1278 | 10 | 115/200 | 30 | 70 | Thermostat | Misc. | 10 | 8 | | 7⅝ |
| C-1320 | 27 | 115/200 | 170 | 36 | Thermostat | Misc. | 27 | 11⅞ | | 6 |
| C-1271 | 30 | 115/200 | 150 | 46 | Thermostat | Misc. | 25 | 16 | | 4 |

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thrust vector which balances the weight vector decreases. With the thrust-weight ratio of approximately 1.1 at takeoff, the limit angle at which vertical thrust equals weight is about 30 deg.

Because of the low damping and quick response of the Atar to thrust inclinations, any angularity in flight path has to be small and corrected rapidly to avoid getting into a range where the whole unit could fall to the ground even though operating at full thrust.

Like the helicopter, the Atar Volant has a critical altitude range during vertical flight. Obviously the lower limit is the 26-ft. height at which the pilot sits with the machine on the ground. The upper limit of the critical altitude range is the height at which the ejection seat will guarantee a safe ejection. This varies with attitude, being lowest for the vertical position and increasing somewhat as the vehicle tilts. Exact figures are not available because live tests have not been made.

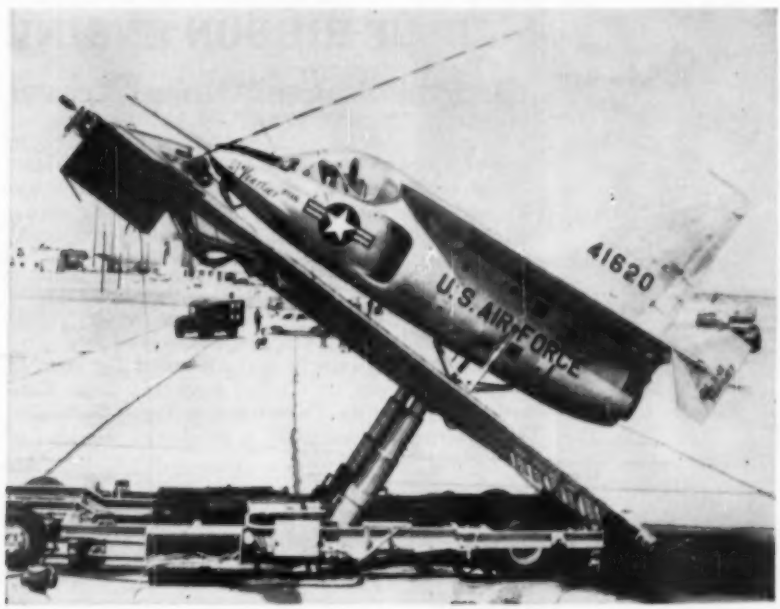
Snecma engine designation for the Atar modified for vertical flight adds a letter V to the basic engine type. Thus the engine in the P.2 is the Atar DV, basically the D series used in production Dassault Mystere II fighters. The D engines went out of production in 1956 and were replaced on the line by the E series. Snecma says that any of the Atar line can be made available in a V engine.

### Test Structures

Three special engine test stands, 100-ft. high gantry structure and a family of ground vehicles were developed in parallel with the Atar Volant.

First of the test benches was a simple rig mounting the Atar in a vertical position to check the ability of the engine to operate for long durations in that attitude. Standard Atars, like other jet engines, can operate normally for only a brief period in a vertical attitude because of the change in loading on the bearings and difficulties in lubrication.

Second of the test rigs was more sophisticated. It mounted the engine




## Ryan X-13 Impresses Andrews Audience

Like the Flying Atar at the Paris air show, the Ryan X-13 Vertijet VTOL made an impressive public debut last week at the Golden Anniversary of Airpower show at Andrews AFB, Md., last week.

Similar in concept to the Atar in that it uses thrust from a turbojet engine—a Rolls-Royce Avon in this case—to rise from a vertical attitude, the X-13 is in a more advanced state of development in that it has acquired wings and fuselage and has made transitions from vertical to horizontal flight (AW May 13, p. 29).

X-13 also uses bleed jets, mounted at the wing tips, but obtains thrust deflection by movement of a gimbal mounted exhaust. It is carried on a trailer, which is shown rising into vertical position for launch. In the Andrews demonstration, the pilot ran the engine several minutes on the ground to burn off fuel, a technique also used by the Atar. X-13 to land returns to a vertical position, maneuvers tail down to the upraised platform and engages its nose hook in a cable visible at the left of photo.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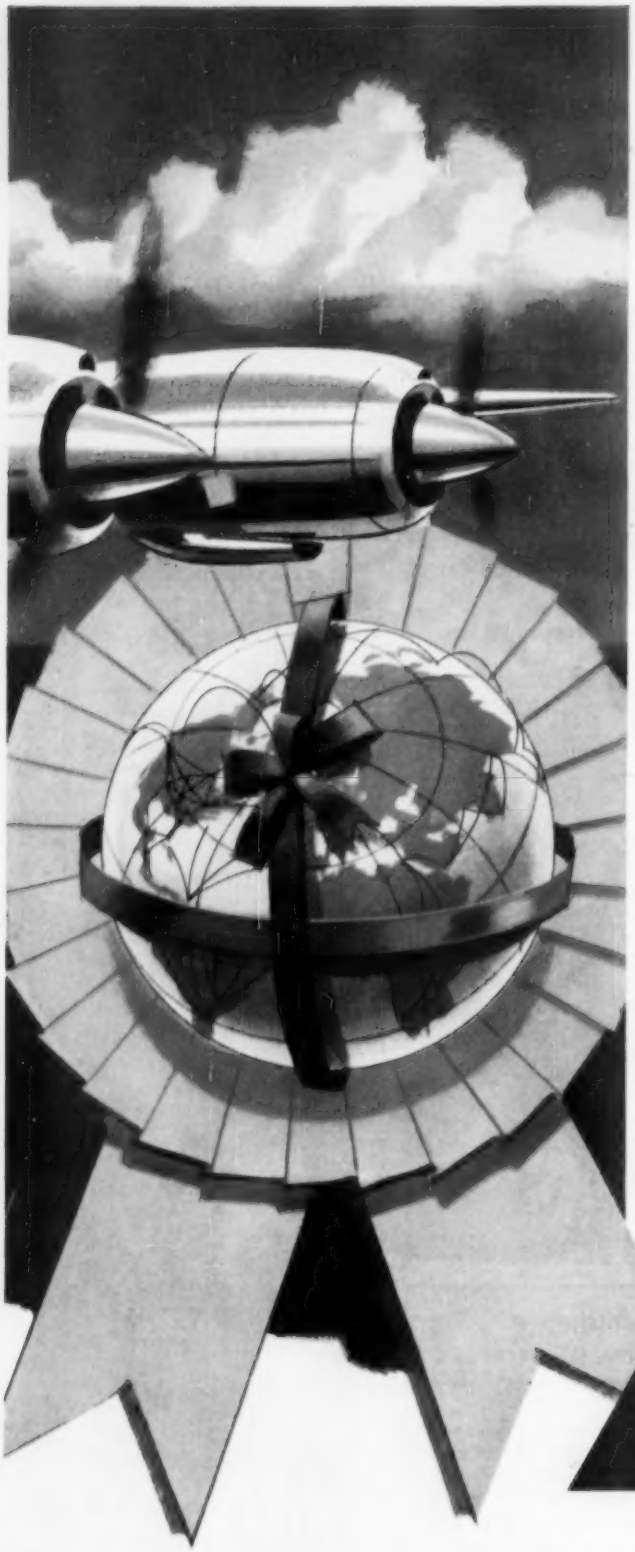

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in a fixture which allowed the engine to be rotated in a vertical plane from a horizontal attitude to a vertical one. Primary purpose of this rig was to add another degree of motion to the vertical engine and to check its operation at sustained high levels of thrust over long periods of time.

Third of the engine test stands mounted the Atar at its center of gravity with complete freedom for the engine to rotate and pitch about that point up to a moderate angular travel. This gimballed engine was actually the final stage of the static test program and became, after its tests on the stand, the radio-controlled C.400 P.1.

Tethered flights of the P.1. were made under the protective arch of the gantry structure with five cables secured to the engine for safety. Here the first free flights were made under radio control from a nearby trailer. The pilot's position in the trailer was a prototype for the system designed for the final manned model of the Atar Volant.

In addition to the trailer for flight control of the tethered rig, Snecma engineers developed a special ground vehicle for transporting and erecting the Atar. Similar in concept to the Le Tourneau Transporter for the Corporal missile (AW July 22, p. 59), the Snecma carrier mounts the Atar Volant in a horizontal position on a boom which swings to the vertical position to unload and erect the Atar.

### Development Program

Original program for the Atar Volant was laid out at the beginning of the company's studies in 1952, aimed at the eventual goal of a complete aircraft capable of vertical takeoff and landing, with transitions into horizontal flight paths. The program as planned for the vehicle was split into theoretical studies of stability, control, ground effect and the like, to be supplemented and checked with experimental trials of test vehicles.

First of the test vehicles to fly was a modified Snecma Ecrevisse pulsejet rated at a thrust just under 100 lb. Major reason for starting tests with a pulsejet was that it eliminated the gyroscopic forces present in a moving turbojet and thus simplified by one degree of freedom the analysis of the flight tests. This unit started tests in 1954 as a tethered engine under control from the ground in a test cell at Snecma's engine development center at Melun-Villaroche.

Next step in the development vehicle program was to modify a standard Atar for operation in a vertical attitude for long periods of time. Long periods, so far in the Atar Volant program, have meant flight durations of only a few minutes because of the fuel limitations in the current vehicle. But later aircraft designs could have much more duration and therefore the tests of vertical operations were carried through with auxiliary fuel feed systems.

Engineers anticipated troubles with the lubrication system of the engine and with the main roller bearings because both are designed primarily for the requirements of level flight. But as it turned out, no changes were necessary in the bearings. Only the lubrication system was altered and that slightly.

### Angularity Added

Having proved the operation of the engine in a vertical attitude, Snecma engineers next tried the effects of motion in a single vertical plane. The Atar engine was mounted in a special test stand which permitted the engine to be rotated around its mounts in a plane; angular limits could be varied between horizontal and vertical. Tests such as these gave the first indications of transient characteristics of the engine during the transition from vertical flight to a horizontal path.

With this series of tests behind them, the next logical step was to mount the engine so that it was completely free to rotate or pitch about its center of gravity. Thus stabilization and control could be checked. The Atar was slung at the CG in a gimbal

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# Tested and Approved by the British Royal Aircraft Establishment

**KEARFOTT T2502 GYRO**
Dimensions: 3⅜" diam. x 6-3/16" long
Weight: 6.5 pounds max.

After an exhaustive test program conducted at the Royal Aircraft Establishment Farnborough, England, the Ministry of Supply selected a Kearfott floated rate integrating gyro for a major defense program in Britain. This gyro is the Kearfott Model T2502 which represents the most precise production gyro available today. Does not require daily trimming nor compensation. Suitable for inertial guidance or any application which demands the day-to-day precision inherent in this gyro.

This floated rate integrating gyro is hermetically sealed for complete protection in any environment and to permit operation at extreme altitudes. The input axis is located by an indexing notch on the mounting diameter. The values tabulated represent the day-to-day characteristics of this gyro.

## CHARACTERISTICS

| | |
|---|---|
| Gimbal Freedom | ±3° |
| Angular Momentum | 6.05 x $10^6$ GM $CM^2$/Sec. |
| Torque Linearity | 1.5 dyne-cm |
| Drift Rate | .05°/Hr. RMS of deviation from average rate |
| | .15°/Hr. maximum speed |
| Mass Unbalance | ½°/Hr. RMS |
| Temperature Control | ±1°F |
| Warm-Up Time | 30 minutes |
| Power Required: | |
| Motor-Starting | 12½ Watts |
| Running | 6 Watts (115V, 400 cps, 3 phase) |
| Pick-Off | 5V, 400 cps, single phase |
| Torque | 100 ma DC (Max) |
| Heater | 50 Watts (Max) 28V DC |

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Little Falls, N. J.

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mounting on a specially built test stand and put through a complete program of thrust and attitude variations. Auxiliary fuel was added here so that the running time of the test could be any length desired.

This was the last stage in the development of a restrained test vehicle. The Atar used in the free-motion stand was then converted so that it became the first of the free-flight test vehicles, the unmanned C.400 P.1. Radio controlled and tethered to the gantry by five safety cables, this vehicle started its flight tests in 1956 and has made more than 250 tethered flights since.

Flight time on this vehicle has been limited to a maximum of about seven minutes per test because of the fuel limitation.

### Manned Vehicle

During the development testing of the P.1, engineers were designing and technicians were building the P.2, a manned piloted version of the P.1. test vehicle. Where the P.1 had a simple engine inlet screen, the P.2 sprouted a trusswork frame holding an ejection seat and pilot's controls.

The P.2 was to be flown first in tethered flights and later in free flights by Morel. He had begun flying the P.1 in 1955 from its ground trailer, and at the end of February 1957 made the last P.1 flight.

By March 6 the P.2 was ready for tie-down tests to check the systems operations. Between then and March 30 about 30 tests were made with the P.2 restrained from flight.

March 30 Morel eased the P.2 off the ground under the shadow of the gantry for the first manned tethered flight, beginning the final check of the stabilization system preliminary to free flights.

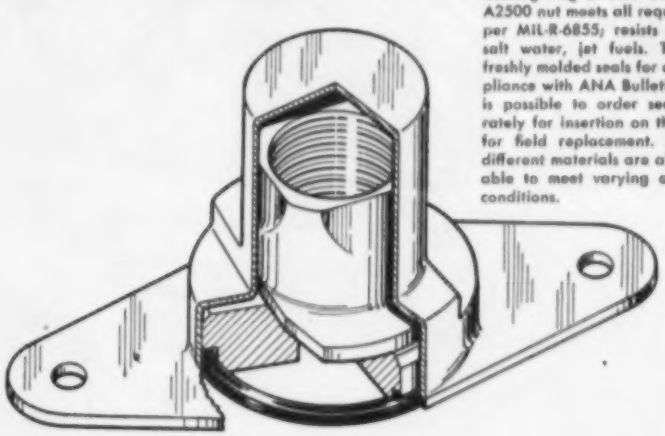
Finally on May 14 Morel climbed the twenty steps of the mobile maintenance platform parked alongside the Atar Volant. Below, the fuel pumps of the ground truck whined to silence and the truck pulled away. The Atar moaned, screamed and then roared into life as Morel went through the starting sequence.

### Free Flight

Then the shiny cylinder moved upward. The shock struts on the outriggers lengthened and Morel was underway on his first free flight. Balanced on the howling exhaust, the P.2 eased upward and climbed slowly as Morel gently advanced the throttle and felt the sensitive response of the vehicle.

While the P.2 test program moves along, work is nearing completion on the P.3 test vehicle, basically the P.2 with an enclosed cabin. Primary purpose of this version of the Flying Atar


**FASTENER PROBLEM**



Sealing ring of new ESNA type A2500 nut meets all requirements per MIL-R-6855; resists gasoline, salt water, jet fuels. To insure freshly molded seals for easy compliance with ANA Bulletin 410, it is possible to order seals separately for insertion on the job or for field replacement. Rings of different materials are also available to meet varying operating conditions.

# Leakproof self-locking fasteners for integral fuel tanks

Aircraft designers have eyed the space-saving possibilities of "Wet Wing" or integral fuel tanks for some time. But . . . the "wet" section of the wing must be fastened in such a way that highly volatile aviation fuels will not leak under the base of the tank fasteners or seep out along their bolt threads.

ESNA has just developed the first completely practical answer to this problem. The new ESNA type A2500 floating anchor cap nut (see diagram) is a self-locking anchor nut with an "O"-ring seal in its base. In tests, the nut has maintained a perfect seal against pressures above 50 psi on either side, regardless of structural strain, vibration, or temperature changes. The seal is effective whether the bolt is installed or not. It is not destroyed by repeated bolt installations.

The type A2500 is the lightest nut of its type; 100 nuts weigh only 1.2 pounds. It meets AN-N-5 specifications for operation between −80° F. and +250° F. and can be used for extremes beyond these limits by varying its component materials such as the "O"-ring. It provides .050-inch maximum floating action allowing quick assembly in spite of slight misalignment of bolt holes. *The A2500 is 100% seal tested prior to shipment.* The basic design has been approved by the USAF. Sizes range from 10/32 through sizes 1/4-28, 5/16-24, 3/8-24, and 7/16-20. A gang channel strip providing a series of regularly spaced A2500 nuts has also been designed.

The new Boeing 707 Jet Transport is among the first aircraft equipped with integral wing fuel tanks fastened with the new ESNA type A2500 leakproof nut.

**MAIL THE COUPON FOR DESIGN INFORMATION**

ESNA

**Elastic Stop Nut Corporation of America**
**Dept. N74-825, 2330 Vauxhall Road, Union, New Jersey**

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☐ Details on A2500 nuts installed on gang channel strips.

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is to check the design of the rotating seat developed as part of the overall vehicle program. The flight test program of the P.3 will be limited to near vertical attitudes only, because the Atar has no aerodynamic lifting surfaces and does not have enough power and control to tilt safely much more than 15 deg. from the vertical.

But the P.3 is also scheduled to go into the test stand that completed the program of the P.1, where three degrees of freedom can be given to the engine. The whole vehicle will be "flown" through a simulated program from vertical takeoff through transition to and from horizontal flight and back down to a vertical landing.

What comes after the P.3? Snecma isn't saying much. It does hope the flight tests will excite enough interest to get a VTOL aircraft project started somewhere in the French or foreign industry. Its own interest in such aircraft centers around the coleopter concept patented by Von Zborowski, whose study bureau has been turning out drawings and models of everything imaginable from bazooka shells to transports, all bearing the hallmark of the annular wing.

Rights to the Von Zborowski patents have been bought by Snecma. There has been engineering liaison between the two concerns, although there is at present no direct connection other than the patent-rights agreement.

Part of the Atar Volant's future is tied up in the success of the test program, which so far has been going favorably. But by far the bigger part of its future depends simply on that of the entire French aircraft industry. Technically healthy, the French industry is bedeviled by the same economic difficulties that face the country as a whole.

If France pulls out of its current crisis, lifting the hopes of the aircraft industry with it, then there is a future for the Atar Volant. If the financial situation forces further regrouping of the aircraft companies and further economies in the country's military program, then the chances are great that the Atar will join many other promising French aircraft designs in a limbo of lost opportunities.

## C-130 Makes Two Engine Transcontinental Flight

Lockheed C-130 Hercules turboprop transport flew nonstop from Eglin AFB, Fla., to Norton AFB, Calif., on two engines as a test mission.

Two of the airplane's four Allison T56 engines were feathered to determine airplane's limited power capabilities. Flight brought many reports from observers that plane was in trouble.

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**TEST** objects ingested by JT3 and JT4 engines included birds, tools, clothing.

# CAA Sets Rigid Standards for Certificating JT3, JT4 Engines

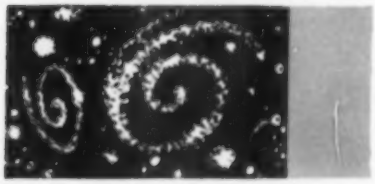
Civil Aeronautics Administration certification of Pratt and Whitney's JT3 and JT4 commercial turbojet engines involved a test program with many requirements never encountered in checking out piston engines in the past. The manufacturer formally requested CAA participation in September, 1956, and both engines received their certification last March. JT3 is J57; JT4 the J75.

Requirements included:

- **Accessory drives** to run trouble-free for 150 hr. at maximum loads.
- **Fuel system** to check out under 500-hr. test from −65F. to 300F. Fuel was purposely contaminated to demonstrate system reliability, accuracy of metering, endurance of parts.
- **Compressor and turbine** discs to withstand high degree of overspeeding.
- **Engine to ingest** hailstones without mechanical trouble.
- **Anti-icing** equipment to be adequate to protect compressor inlet section.
- **Engine** not to cause aircraft damage when the engine is subjected to severe internal damage.
- **Operation** of engine not to be adversely affected by extraction of air for airplane requirements.
- **Engine** to operate satisfactorily when accessory drive component is loaded to maximum permitted.
- **No destructive** vibration to exist in blades and vanes of compressor and turbines.
- **Turbine** be able to withstand temperatures higher than would be approached in service use.

To prove that its jets could ingest ice

**LOOKING TO THE FUTURE!**



Today, it's the conventional engines for fixed wing and helicopter equipment — R-1820, R-1830, R-1340, R-985, R-2000, R-2800 CA and CB, R-3350, R-4360, Lycoming and Continental engines. Tomorrow, it will be the jet and the turbine engine.

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BERNARD SIMONS, Senior Project Engineer on the Convair 880 Jetliner. A graduate of the University of Detroit, Mr. Simons joined Convair-San Diego nine years ago as an engineering designer. He is respected for his contributions to jet airliner advancement — as well as his ability to develop engineering talent.

# "Engineers...here's how we combined aileron and spoiler functions in our new Convair 880 Jetliner."

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"Important as this project is, it represents only *one* of the many creative assignments being solved at CONVAIR-*SAN DIEGO* – projects like our 880 Jetliner and F-102A Interceptor.

"You will enjoy this *diversity* of activity. You'll like the Convair atmosphere, where you see and feel accomplishment. And you will enjoy living in beautiful, smog-free San Diego.

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without damage, P&W fired two-inch ice balls from a cannon into the compressor at 600 mph. In other tests, cannon fired dead birds into the engine, resulting in no damage except slight compressor blockage "due to feathers."

The series of tests which led to certification of the engines was performed in the company's East Hartford, Conn., plant by P&W engineers in cooperation with CAA experts.

## AMC Contracts

**Wright-Patterson AFB, Ohio**—Following is a list of unclassified contracts as released by the Air Materiel Command.

**Fairchild Camera and Instrument Corp.,** Robbins Lane, Syosset, N. Y., product improvement of KC-1 mapping camera, special tools and test equipment and data, 1 ea., (PR 564672 and PE-564672-1), $314,037.

**Sundstrand Aviation Div.,** Sundstrand Machine Tool Co., Rockford, Ill., transmission and governor assy., frequency and load controller, automatic paralleling control, recirculating valve, boost pump, component spare parts, MT & TE, and data. All items are part of the constant speed drive for the F-101 aircraft. (PR 694398, 694399, 635723-1 and 635722), $1,231,105.

**Western Electric Co.,** 3 South Latham Road, Greensboro, N. C., control, radar unit, Type C-412/APS-23 (PR WR-674005 and WR-674009), $51,100.

**Eclipse Pioneer,** Bendix Aviation Corp., Teterboro, N. J., indicator ID-387/ARN used with AN/ARN-14 radio receiving set, 5,342. (PR 670958 and MIPR R57-818-41 and amendment #1. MIPR R57-861-72 and amendment #1), $2,355,822.

**Allison Div.,** Aeroproducts Operations, General Motors Corp., Dayton 1, Ohio, governor assemblies, P/N 6502743, regulator assemblies, P/N 6502775, valve assemblies, P/N 6502865 for C119G propeller spares (PR WR-739261) $519,560.

**Hughes Aircraft Co.,** Florence Avenue and Teale Street, Culver City, Calif., replenishment spare components and maintenance spare parts for the E-Series fire control system. (PR 00787822, 00757502, 00555378, 00555378-1, SM537254, 00786793, 00786793-1, WR681072, SM537273, and 00787513) $1,016,687.

**Propeller Div., Curtiss-Wright Corp.,** Caldwell, N. J., propellers type CT7358-B116/1060-2105-12, associated components, spare parts, tools, and data for the C-133 aircraft. (PR PE-672089) $3,039,004, material and services to cover product improvement for YC-97J, C-133, C-130, XB-47D and XF-84H aircraft. (PR PE-7-03A-4234) $2,019,432.

**The Leland Electric Co.,** Div. of American Machine & Foundry Co., Dayton, Ohio, motor generators, 250 V, for use on Q-2A, L-123, B-57, F-86, F-100, F-104, F-105 and F-107 aircraft. (PR 694470 and 729469) $891,457; motor generators for B-29, C-46, O-47, F-89D and SA-16A aircraft. (PR SB-503796 and SA-729462) $723,766.

**Burke and James, Inc.,** 321 South Wabash Ave., Chicago 4, Ill., KS-7 copying cameras, 24 ea. tabular list of parts, lot. Literature, lot. Manufacturers drawings, set. (MIPR R57-9200-SC-24 and Amend # 1. MIPR R57-25/G6/C, F/12 N8F/ASO and Amendments # 1 and 2.) $36,153.

**Trad Electronics Corp.,** 1001 First Ave., Asbury Park, N. J., receiver, radio R-122A/ARN-12 for T-33, F-100F and C-133A aircraft. (PR PE-670835 and Amendment #1. MIPR R56-868-207) $102,771.

**Westinghouse Electric Corp.,** 32 North Main Street, Dayton, Ohio, 40 KVA generators, voltage regulators, control panels for B-47 and B-52 aircraft. (PR 694424, 729461, 729460, 729482, 706904, 729470, and 729478) $2,704,774.

**Defense Electronic Products,** Radio Corporation of America, Camden 2, N. J., product improvement AN/ARC-34 command


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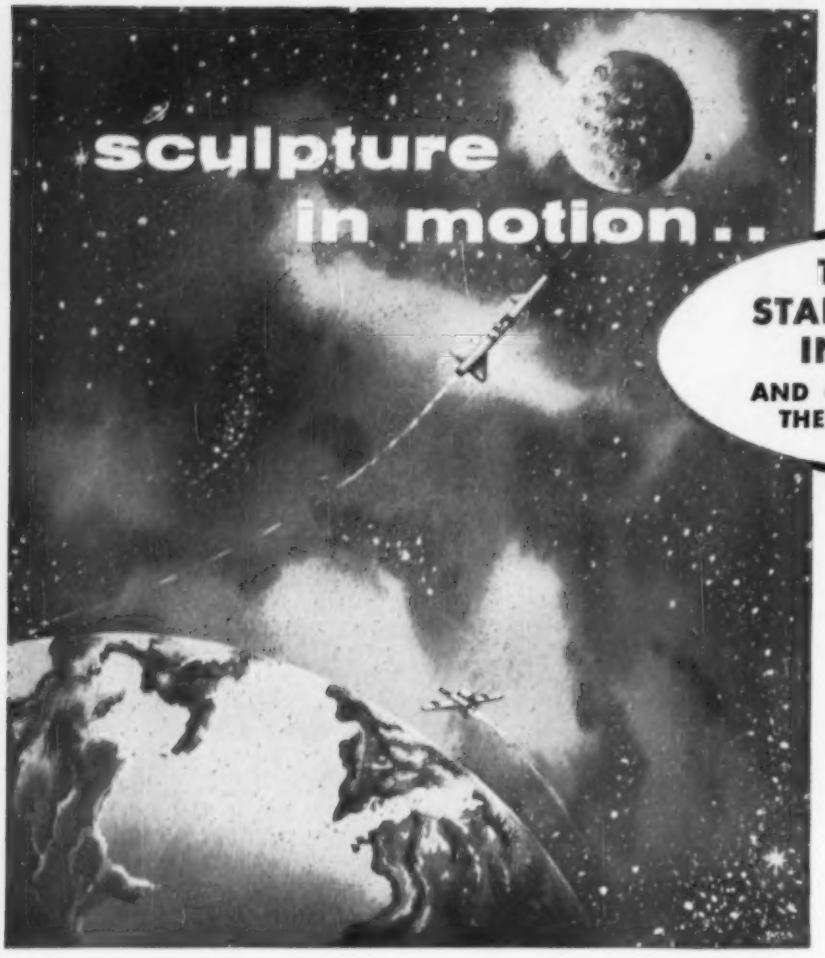


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## Turbine Powered S-58 Flies

**Sikorsky S-58 helicopter modified for installation of two General Electric T58 turbine engines has begun flights extended beyond confines of Sikorsky's Bridgeport, Conn., plant. Modified helicopter began flying last January, but had not left plant area until recently. Engines provide 1,024 eshp. each. Sikorsky is testing noise and vibration reduction, payload and range addition and lesser component wear from use of turbine power under Navy contract. British have modified S-58 for Napier Gazelle turbine engine.**

communications set (PR PE-673728 and PE-673728-1) $1,586,176.

**Waste King Corp.**, 3300 East 50th Street, Los Angeles 58, Calif., type MA-1 pitot static tube for F104A, F104B, RF104A, and ATRC aircraft. (PR 708076) $162,999.

**Sperry Gyroscope Co.**, Sperry-Rand Corporation, Marcus and Lakeville Road, Great Neck, N. Y., MA-2 automatic pilot system for B-52 aircraft (PR PE-622578), $1,150,000.

**Friden Calculating Machine Co. Inc.**, 2350 Washington Ave., San Leandro, Calif., drift-meters, type B-6A, in accordance with drawing MS 28012, for aircraft, (MIPR R35-575-2643 ASC and R35-575-2643 ASC, Amendment # 1 and PR 563929), $174,471.

**General Electric Co.**, 2600 Far Hills Ave., Dayton, Ohio, generators and control panels for applicable aircraft, B-66B/RB-66B and C-133A. (PR 729497, SA-729491 and PE-694406), $527,286.

**Lycoming Div.**, Avco Manufacturing Corp., 652 Oliver St., Williamsport, Pa., O-480-1 aircraft engine for L-23D aircraft. (MIPR-R57-709-TC, amendment No. 2), $325,520.

**B. F. Goodrich Aviation Products**, B. F. Goodrich Co., 803-4 Winters Building, Dayton 2, Ohio, wheel assys and brake assys for C-118A aircraft. (PR 00-T-03H-11), $144,975.

**Pneumafil Corp.**, 2516 Wilkinson Blvd., Charlotte, N. C., mounting, MT-1161/ARN, 1,032 ea. mounting, MT-1162/ARN, 128 ea. mounting, MT-962/ARN, 1,237 ea. (PR 670919 and 670960), $34,463.

**John R. Hollingsworth**, Nutt and French Creek Roads, Phoenixville, Pa., mounting, MT-1151/APX-25, 1321 ea. mounting, MT-1439/A, 1321 ea. (PR 670909 and 670909-1), $26,935.

**The Harwald Company, Inc.**, 1216 Chicago Avenue, Evanston, Ill., film inspecting machine, FM-106, 16 ea. (MIPR R02-790150-SC-01-23), $401,800.

**General Electric Co.**, 2600 Far Hills Ave., Dayton 9, Ohio, type MS28000-1 tachometer indicators for B-52, F-101,102,104,105, C-130, C-133 and KC-135 aircraft. (PR 603556), $277,994.

**R. C. Allen Business Machines, Inc.**, 678 Front Avenue, N. W., Grand Rapids, Mich., type MD-1A, turn and slip indicator for use on F-100 series, F-86 and C-130 aircraft. (PR SM-537270 and PE-603568), $326,816.

**El-Tronics Inc.**, Penn Ave., Mayfield, Pa., control, C-411A/A, used with ARN-7 radio compass, 783 ea. (PR SB-554113), $43,887.

## Army Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Army Contracting Offices:

**PICATINNY ARSENAL, Dover, N. J.**

**Avion Div., ACF Industries, Inc.**, 11 Park Place, Paramus, N. J., pre-launch control & monitary panel, T4007 in acc/w dwg 889-5916, 7 ea.; fuze tester, T4004 in acc/w dwg 8805013, 24 ea.; assembly tester, T4006, in acc/w dwg 8805015, 24 ea.; fault simulators, T4008, in acc/w dwg 8805017, 23 ea.; cable tester, T4005 in acc/w dwg 8805014, 24 ea. (IFB-N-6612), $60,849.

**Harvey Machine Co., Inc.**, 1920 So. Western Ave., Torrance, Calif., metal parts, for primer, percussion, M70, in acc/w AOD coordination & planning office procurement requirement No. 57-16 dated March 14, 1957, 110 units; metal parts, for primer, percussion, M70, in acc/w AOD coordination & planning office procurement requirement No. 57-16 dated March 14, 1957, 440 units, (IFB N-6637), $29,040.

**Omer E. Robbins Co.**, 24800 Plymouth Rd., Detroit 39, Mich., development, design, fabrication, test and delivery of a special automatic machine for the complete assembly and partial processing of a portion of the illuminating bomb, (IFB-N-6468), $335,600.

**CORPS OF ENGINEERS, Jacksonville District, 575 Riverside Ave., Jacksonville, Fla.**

**Process Filters, Inc.**, 1807 Elmwood Ave., Buffalo 7, N. Y., furnishing liquid oxygen, fuel, helium, and nitrogen filters for launching complexes Nos. 15, 16, 19, and 20, Cape Canaveral Auxiliary AFB, Fla., $66,880.

**Byron Jackson Pumps, Inc.**, 201 Stokes Bldg., Greenville, S. C., furnishing miscellaneous pumps for launching complexes Nos. 15, 16, 19, and 20, Cape Canaveral Auxiliary AFB, Fla., $261,520.

**Chicago Pneumatic Tool Co.**, 6 E. 44th St., N. Y. 17, N. Y., four 50-kw. diesel engine generator units and auxiliaries for Bomarc-Sage Power Plant Building, AFMTC, Patrick AFB, Fla. (ENG-08-123-NEG-57-50) $242,000.

**Radar and Associates**, 111 N. E. 2nd Ave., Miami 32, Fla., design of G/M Guidance Facility (GE Mod III System) (WS-107A-1) Patrick AFB, Fla., $26,000.

**CORPS OF ENGINEERS, New England Division, 150 Causeway St., Boston 15, Mass.**

**Kieley and Mueller, Inc.**, 64 Genung St., Middletown, N. J., design and fabricate 50 liquid metal valves for Connecticut Aircraft Nuclear Engine Laboratory, Middletown, Conn., (DA-19016-ENG-5242) $362,683.

**U. S. ARMY ORD. DIST., Los Angeles, 55 S. Grand Ave., Pasadena, Calif.**

**Douglas Aircraft Co. Inc.**, 3000 Ocean Park Blvd., Santa Monica, Calif., supplies and services relating to the Honest John

Honeywell Aero's HIG-6, one of the most precise gyros ever designed, is now in quantity production. With a drift rate of less than 0.1 degree per hour, it represents the furthest advance yet made in a production, inertial-type gyro. The HIG-6 is applicable to both full inertial and aided-inertial systems. Standard models of this gyro can be delivered in as little as three months' time.

MINNEAPOLIS
**Honeywell**
H Aeronautical Division

## Sabreliner Engines Are Relocated

**Engines of North American Sabreliner, originally buried in wing root (AW July 1, p. 82), have been relocated in pods on aft fuselage. North American says change was made solely to gain a cleaner wing configuration for the aircraft, which was designed at company expense to meet a USAF requirement for an off-the-shelf light transport and crew readiness trainer. New design is similar to Lockheed CL-329 which has four engines podded on aft fuselage and to the Sud Aviation Caravelle commercial transport. Lockheed airplane also was designed to meet same general requirement.**

# Bristol Pushes Gear Changes To Meet Northeast Schedule

**London**—Despite growing tension in Britain over what have been called "very, very silly" requirements of the U. S. Civil Aeronautics Administration, Bristol Aircraft Ltd. is pushing ahead with required landing gear modifications of the turboprop Britannia to meet delivery schedules to Northeast Airlines.

Bristol is taking the attitude that "the CAA requirements exist and if we want to sell aircraft in the U. S., we will have to meet them." Although there have been reports to the contrary, the firm says it will deliver the Northeast Britannias in time for the airline to meet winter vacation schedules to Miami.

Lord Brabazon, chairman of Britain's Air Registration Board, stirred up considerable feeling here when he declared recently that relations with the CAA and Civil Aeronautics Board are none too friendly.

"We in these islands, and especially in the ARB, believe that our British standards of airworthiness are good," he said, "but we are quite prepared to respect the standards of other countries and we certainly respect those of the United States. But we expect them to accept ours. We do not want to see a battle of special requirements, because some of the special requirements are very, very silly."

### Won't Argue

Bristol may feel that some of the CAA requirements it has to meet are out of date, but the company is taking the stand that its job is to meet the requirements not to argue about them.

There is no question that the CAA landing gear requirement for the Britannia's bogie gear, and the belated insistence on meeting the requirement, were greeted with little enthusiasm at the Bristol plant. But the firm's attitude averted what would have been a considerably greater embarrassment.

Earlier this month, at the same time Bristol engineers were pushing through a redesign to strengthen the gear to meet CAA requirements, landing gear of a Britannia snapped while the aircraft was under tow at Vancouver, B. C.

Pertinent CAA requirements calls for ability of the aircraft to pivot on the center of its undercarriage. The Britannia, which employs bogie gear, is not designed for such pivoting. To satisfy requirements of Britain's ARB, Bristol has declared a 15-ft. turning circle for the Britannia 100 and a 20-ft. circle for the Britannia 300 and provides what it considers adequate strength to meet those requirements.

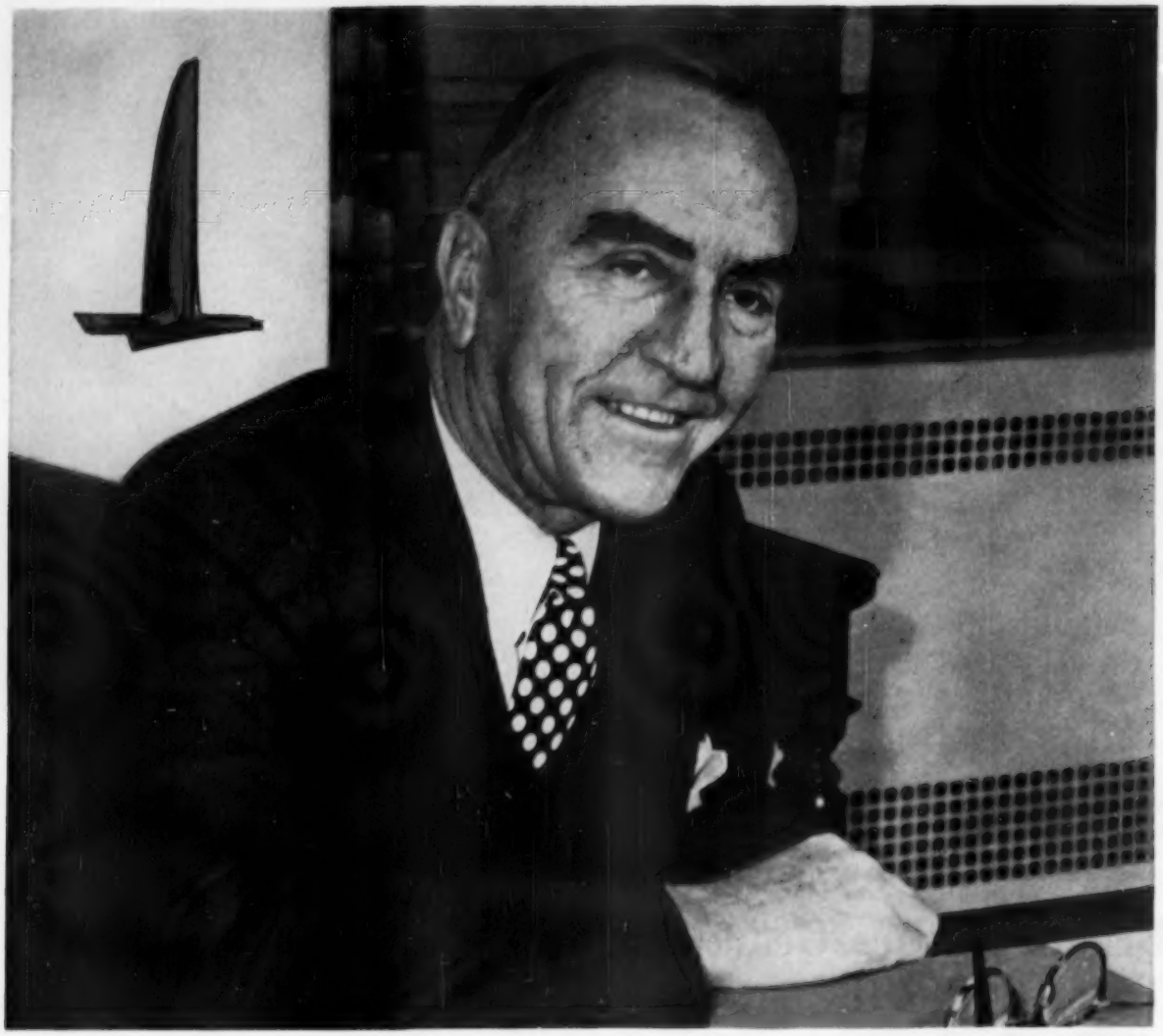
CAA has insisted on a pivoting case which will give 2.7 times the load of the previous torque case and has asked for modifications on the braking rod and the springback case for the radius rod.

### Major Change

The landing gear changes are the major modification time-wise which the CAA has called for on the Britannia. They will mean a total undercarriage weight increase of about 300 lb. per aircraft.

There is a 50-deg. limit on the nose steering of the Britannia to avoid excess strain on the main gear. There is a warning indicator on the nose wheel as well as a warning horn which sounds if the limit is exceeded.

In the Canadian incident, the Britannia was being towed in darkness at 3



# "Protecting our passengers and the tremendous investment Eastern has in 20 new DC-8 jets will be our biggest job"...

*says Captain Eddie Rickenbacker, President, Eastern Airlines*

By its single purchase order for 20 new Douglas DC-8 jets, Eastern Airlines makes the largest capital investment in its history. Naturally, realizing a profitable dollar return on these aircraft requires taking every precaution to protect them. Customers expect it, and stockholders demand it.

Thus, Eastern will have fire-resistant Skydrol-500 hydraulic fluid in its new jet fleet. Skydrol has flown more than 6,500,000 hours with 34 major airlines throughout the world . . . it's the only fire-resistant hydraulic fluid approved by the CAA.

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a.m. with two Douglas DC-6s being run up alongside. Operator of the tug declared he did not hear the warning horn because of the noise of the other aircraft.

A scissor of the main gear of the Britanina 310 snapped and the company was forced to fly a new leg out before the aircraft could make its return flight to England.

CAA's landing gear strength requirement has existed for some years. But when the question was not raised in two sessions with CAA representatives last year, Bristol assumed the requirement was not applicable to the Britannia's bogie gear.

### Question Unraised

On July 4 of this year, the company was informed by letter it would be expected to comply with the requirement. This was the last of the CAA requirements to be laid down for the Britannia and is the major structural modification. Only other structural modification called for was strengthening of control surface hinges, according to the manufacturer.

To meet CAA specifications, Bristol is providing the Britannia with a slightly heavier top forging with large increases in the material around the scissors legs. New bottom end fittings also are required, as well as a new bogie forging with more material around the pivot pin.

Scissors themselves have been changed from light alloy to steel and increased in weight from 9 lb. each to 33 lb. Since there are four scissors per aircraft, this means a weight increase on the scissors alone from 36 lb. to 132 lb.

Although not so severe on Northeast's shorter-range 305s, the total undercarriage weight increase of 300 lb. can be a considerable penalty on the long-range version of the Britannia.

### Time Stress

Crucial point time-wise is the need for a heavier bottom steel fitting. This is a complex forging. "When you have to call for a new forging like this one, you're really up against it," a Bristol engineer said.

A month was spent on redesign of the gear. The time might have been longer if Bristol engineers had not already been studying heavier gear in looking ahead to Britannias of higher gross weights. The heavier forging, for example, already had been envisaged for larger aircraft.

Britannia undercarriage is built by British Messier Ltd.

Bristol plans to deliver Northeast's first Britannia in November with a "British" undercarriage. The second and third airliners to be delivered to Northeast in the first half of December

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Though fingers may look alike, close examination of the fingerprints always finds a difference. As closely as conventional and Rolle laboratory controlled castings may resemble each other, a close look finds a difference there, too.

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Reduced weight and higher strength are now casting realities. Thinner sections, lighter parts are now possible. Castings can be stressed to new limits. Alcoa's new high-strength process guarantees you high properties.

Formerly, the properties of a casting were based on separately cast test bars. In design and application, a casting factor had to be applied to reduce these properties. With Alcoa's new high-strength casting method, properties are based on bars cut right from the casting itself. No reducing necessary. And, best of all, the guaranteed properties are in *all* the castings in the run . . . consistent, guaranteed, high properties in castings for aircraft structural parts.

New carefully controlled foundry practice and improved alloys are the developments responsible. The alloys are A356 and C355. These are the same composition and meet specifications for familiar alloys 356 and 355, with one difference: Impurities are controlled to a new minimum. Iron content, for example, is held to 0.2% in the improved alloys. Such seemingly minor changes make a whale of a difference.

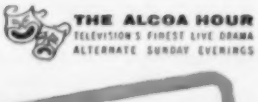
Equally careful control in all steps of the foundry process, plus several new Alcoa developments in aluminum foundry techniques, is also vital in making these high-strength castings.

High-strength castings can be made in sand or plaster molds . . . sometimes in permanent molds. Alcoa's standard guarantee of properties for alloy A356-T61 is 38,000 psi tensile, 28,000 psi yield, and 5% elongation. Occasionally, because of complex shapes and designs, high strength can be furnished only in certain areas of the casting. But, by working closely with the designer, Alcoa can usually put the high strength right where it's needed.

Your Alcoa sales engineer has the facts on this new process. Let him work with you in obtaining castings with high properties—properties that don't have to be reduced in application. Aluminum Company of America, 1800-H Alcoa Building, Pittsburgh 19, Pennsylvania.

*Important missile structural castings for Douglas. Alcoa's high-strength casting process and alloy A356-T61 give them some of the highest properties ever cast. Here are the properties obtained on test bars cut from the castings.*

| | *Tensile, ksi* | *Yield, ksi* | *Elongation, %* |
|---|---|---|---|
| *Front Casting* | | | |
| Average | 43.2 | 32.1 | 9.7 |
| Maximum | 44.4 | 34.1 | 11.0 |
| Minimum | 40.5 | 30.3 | 6.7 |
| Tests—8 from 8 production runs | | | |
| *Back Casting* | | | |
| Average | 45.1 | 34.3 | 5.5 |
| Maximum | 47.1 | 36.9 | 9.0 |
| Minimum | 40.2 | 32.2 | 4.0 |
| Tests—22 from 12 production runs | | | |
| **Minimum Required** | **40.0** | **30.0** | **3.0** |



*Your Guide to the Best in Aluminum Value*

will have "American" landing gear. The first of these two will carry across the Atlantic a new undercarriage for the first airplane.

Remaining two aircraft of the Northeast order are to be delivered in January and February.

The aircraft are being modified to CAA and Northeast requirements at Bristol's main plant at Filton after being flown over in stripped condition from the Short Bros. and Harland plant at Belfast, Ireland.

Delivery of the first aircraft with unmodified undercarriage is expected to enable Northeast to go ahead with crew training without waiting for completion of the modification.

## Merger Is Discussed By General Dynamics

General Dynamics Corp. and Liquid Carbonic Corp. are discussing a merger which, if completed, would unite two corporate giants with strong aircraft and missile interests.

In a joint statement issued last week by the two firms, Frank Pace, Jr., General Dynamics president, said his company's philosophy is to develop the tremendous potentials of the aerodynamic, astronautics, hydrodynamic, electronic and nuclear technologies.

"A logical extension, therefore, of the corporation's activities is an entry into the chemical field, especially with respect to compressed and liquid gases which are extensively inter-related with missiles, aircraft, applications of nuclear energy, and electronics," Pace said.

Rex L. Nicholson, Liquid Carbonic president, said his firm believes the merger would permit Liquid Carbonic to attain more rapidly and profitably its objectives of expanded activity.

## Lockheed to Build Light Jet at Marietta

Lockheed Aircraft Corp. transferred manufacture and sales of its four or two engine jet utility transport, the UCX (Model 329) (AW July 1, p. 82) to its Marietta, Ga. facility. In addition, Georgia Division sales staff is aggressively pushing civilian applications for the C-130 turboprop transport.

## One-Man Helicopter Flight Tests to Begin

Gluhareff Helicopters, Manhattan Beach, Calif., plans free flight test soon on one-man, strap-on helicopter developed entirely with private capital.

Single bladed machine uses jet propulsion and lightweight, inexpensive keel for structure.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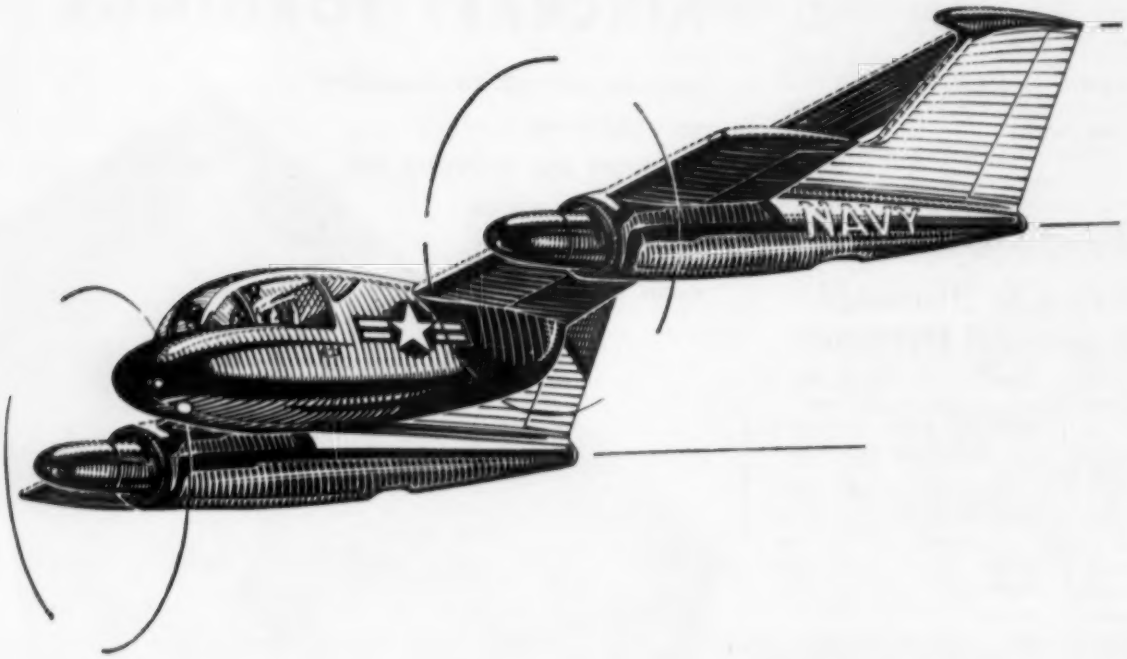
# New STOL Aircraft will dart to 300 mph...




## ...slow to a hover

Kaman Aircraft, under contract to the U.S. Navy, is developing a new and different STOL aircraft concept. Drawing on its experience as a pioneer in the development of turborotor helicopters, Kaman has designed an aircraft which will incorporate the best features of helicopter performance from 0 to 50 mph, and perform as a fixed wing aircraft at speeds up to 300 mph.

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**F-105 HAS FLAPS** down and leading edges drooped for landing. Droop is also used at cruise to give benefits of conical camber.

# F-105 Shows Steep Climb, Weapons Load

Republic's F-105 Thunderchief fighter-bomber, unveiled at the Golden Anniversary Air Show sponsored by the Air Force Assn. at Andrews AFB, Md., is designed to carry a large weapons load either externally or internally in a bay with doors that slide upward into the fuselage.

One of the features of the inlets, not clearly discernible in these first pictures of the airplane, are movable wedges actuated by hydraulically controlled arms. They are inside the inlets on the outer portion toward the wingtips. An NACA development, the wedges are controlled by a system built by Lear.

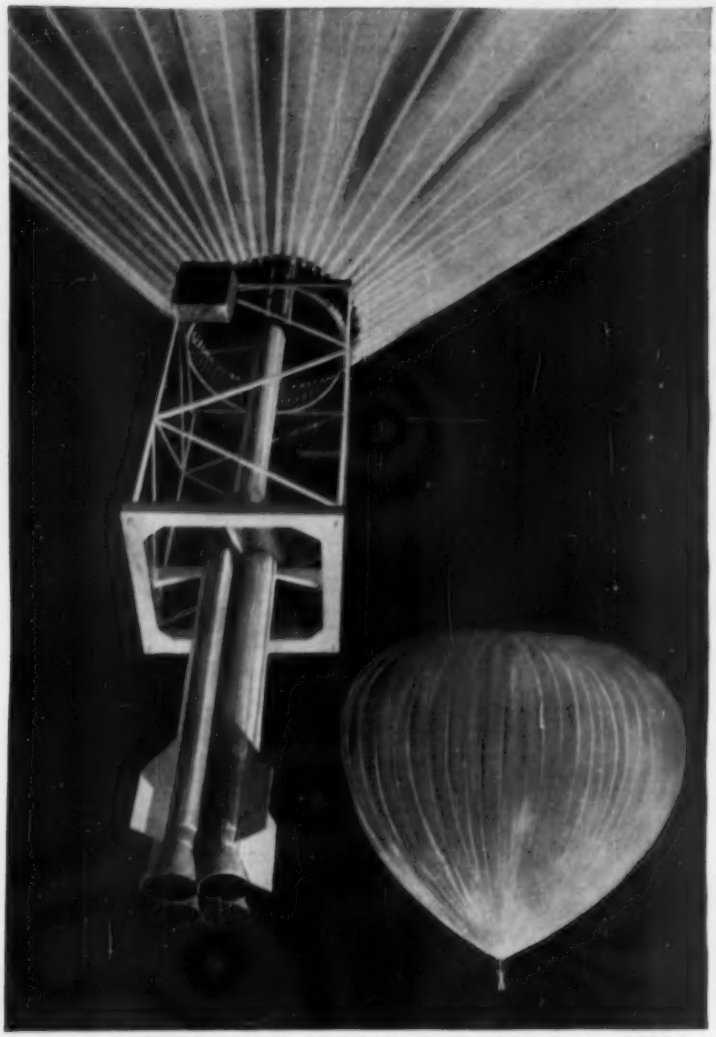
Airplane on display at Andrews was the third F-105B, powered by a Pratt & Whitney YJ75-P3 engine and equipped with $1 million worth of test equipment. After the show it was flown to Edwards AFB, Calif., with three fuel stops en route, where it will be re-equipped with a J75-P5 engine that will go into F-105B production airplanes.

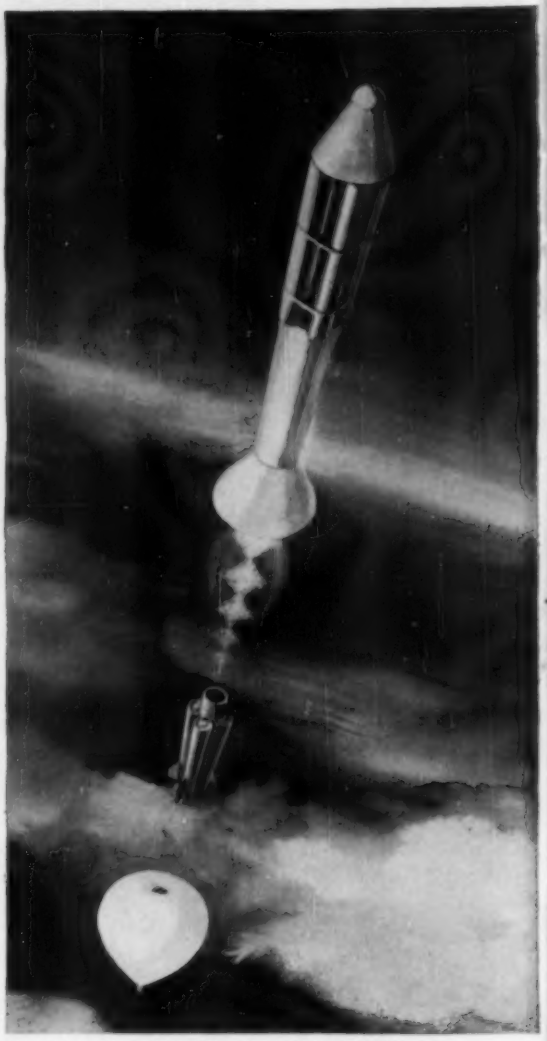
This is an advanced version with two fewer compressor stages and fewer combustor cans.

F-105 has lateral control spoilers on top of wings. Four-petal circular brakes on last three feet of tail were described by pilot as giving good braking control without trim changes. They are used slightly open for landing.

It is air refuelable. Retractable probe is on left side of nose in front of windscreen.

**WEAPONS** load of F-105 is part of fighter-bomber configuration. Aperture in nose is for machine gun.





**BALLOON at 100,000-ft. launching altitude is inflated to full diameter of 200 ft. (left above). At launching, Farside vehicle is fired vertically through apex of the ballon (right). As thrust of first stage rocket engines is completed, second stage engine is ignited. Vehicle includes four rocket stages, 3½-lb. instrument package.**

# Farside Rocket to Fire Through Balloon

Rocket to be used in Project Farside high-altitude tests later this year (AW July 22, p. 29) will blast upward through the balloon which is expected to carry it 4,000 mi. off the earth. Initial first-stage thrust of the vehicle will approximate 160,000 lb.

The 6 x 4 in. instrument package payload of the rocket will weigh 3½ lb. It will be designed to withstand a maximum acceleration of 200Gs during its 8 sec. of powered flight.

### Vehicle Weight

Vehicle itself will gross about 1,900 lb.

Farside program is sponsored by USAF's Office of Scientific Research. Aeronutronic Systems, Inc., a Ford Motor Co. subsidiary, is the prime contractor. Purpose of the project is to gain research data in an environment outside 90% of the earth's atmosphere.

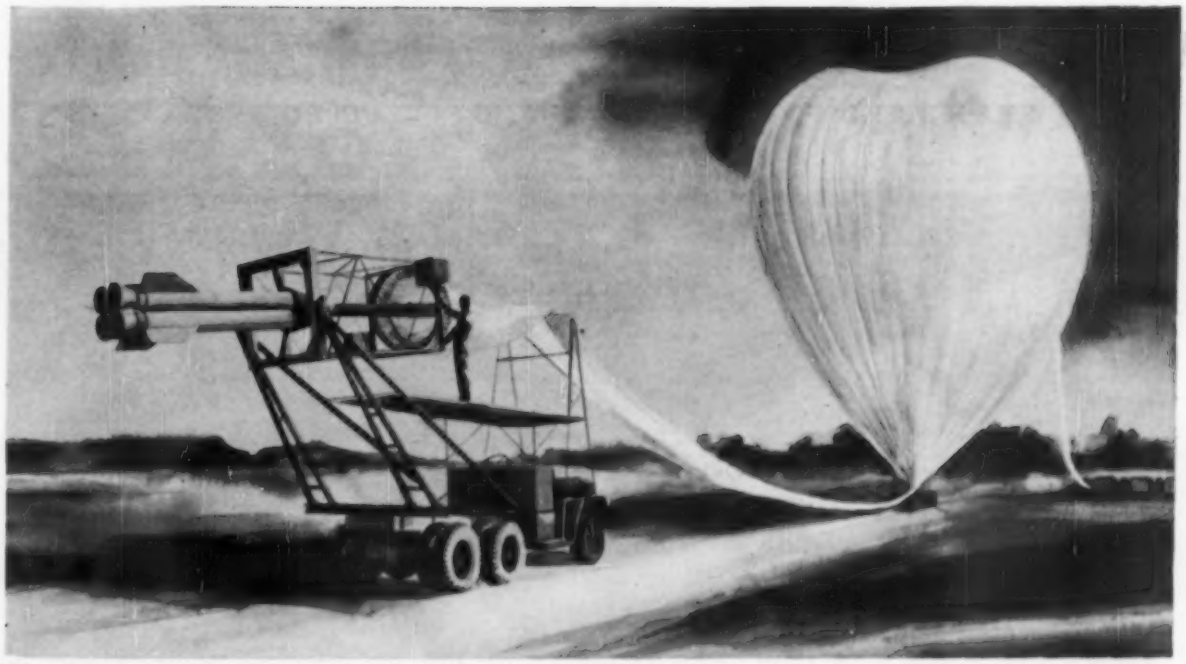
Flight tests with a balloon designed for Farside use were carried out last month at the General Mills Flight Test Center near New Brighton, Minn. The General Mills-built 3,750,000-cu.-ft. balloon reached 106,000 ft. during its flight, automatically releasing its instruments after 5½ hours. The instruments parachuted safely to the ground near Buffalo, Minn.

During the actual Farside tests, a specially developed transmitter will send back measurement of cosmic rays and information on the earth's magnetic and gravitational fields, geomagnetic storm effects, ionosphere measurements, meteorite densities, and the like.

### Four Stages

A cluster of four Thiokol Chemical Corp. Recruit rockets makes up the first stage of the vehicle. A single Recruit makes up the second stage. Third stage comprises four Arrow II rocket engines, and the fourth stage is a single Arrow II with instrument package attached.

Present plans call for a total of six



**PRE-LAUNCH** operation readies payload of 3,750,000-cu.-ft. polyethylene balloon. Farside vehicle and launcher are attached to balloon's aft load ring. Balloon is sufficiently inflated to reach required altitude.

flight tests at the Pacific Proving Grounds during the latter part of September.

Documentation and optical telemetering will be covered by the Air Force's photographic center, Lookout Mt. Laboratories.

Aeronutronic will evaluate the data received after completion of the test program.

### Contract History

Office of Scientific Research in November, 1956 awarded to Aeronutronic a contract to investigate the feasibility of developing a vehicle capable of carrying instruments to a height of several thousand miles.

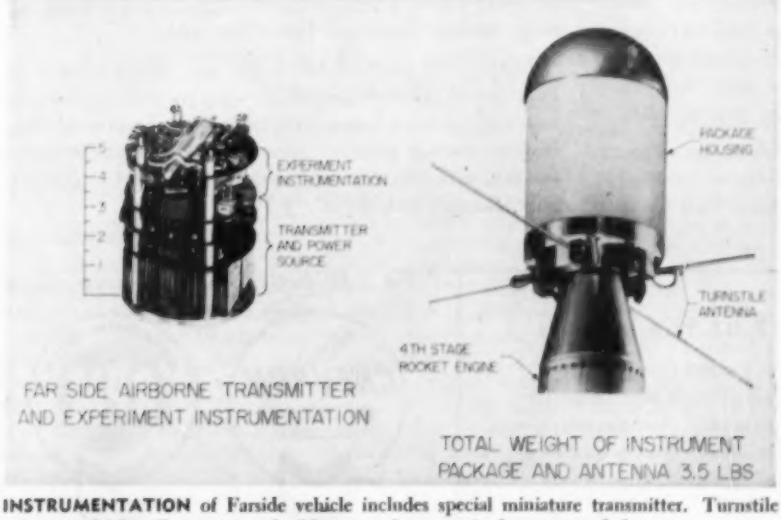
The feasibility study was completed in early 1957, and Aeronutronic then received a contract to build the vehicle.

This contract also provided for the flight testing of the vehicle this fall. Besides Thiokol, Grand Central and General Mills as subcontractors on the project, Prof. S. Fred Singer of the University of Maryland is performing work in connection with the cosmic ray experiment with the project.

Static tests of the rocket engines and their associated ignition systems are now under way at Thiokol's facilities at Elkton, Md. and at Grand Central's Mentone, Calif., facilities. First of the flight test vehicles has been assembled by Aeronutronic at Glendale.

Further pre-launch assembly and operational tests will be performed on each vehicle prior to shipment to the Pacific area.

Ground receiving and recording equipment will be brought from Aeronutronic facilities at Glendale, Calif. it will be erected and checked out at the Pacific site.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PACKAGE HOUSING
TURNSTILE ANTENNA
4TH STAGE ROCKET ENGINE
TOTAL WEIGHT OF INSTRUMENT PACKAGE AND ANTENNA 3.5 LBS

**INSTRUMENTATION** of Farside vehicle includes special miniature transmitter. Turnstile antenna, which will open at end of last-stage burnout, is shown extended.

**CLUSTER** of first stage rocket engines is examined by H. L. Marsch, project director.

# PLANE FAX

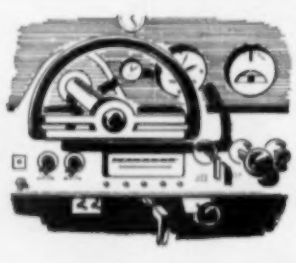
*by* STANDARD OIL COMPANY OF CALIFORNIA

## Planting trout by air into Cascade lakes

"Bombing" mountain lakes with fingerling trout, Sam Whitney has revolutionized Oregon's fish-stocking program. In just one month he "plants" more than 350 lakes by flying 150 feet above the water — high enough for the fish to lose their forward motion before they hit. Pack trains previously spent all summer stocking only 60 lakes.

"Dropping toward those small lakes in timber country can be a lot of fun," says Mr. Whitney, "as long as I know I have enough power to get up and out again. That's why I use Chevron Aviation Gasoline — it *always* gives me the extra power I need, without a miss. It never fouls my plugs, either. There's no better gas made.

"I know RPM Aviation Oil is the best 'engine insurance' I can get. It keeps my planes running smooth and free for hundreds of extra hours, with never a stuck valve or ring. In fact, when a customer comes to my base at Newberg, Oregon, with that trouble, I usually cure it just by flushing out his engine with 'RPM'."



**TIP OF THE MONTH**

It's smart to check all controls every time someone changes seats — it's easy to bump a vital switch or lever.

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**FIRING** of Martin TM-61C missiles across sands of the Libyan desert is facet of 701st Tactical Missile Wing's training program.

# Matador Wing Training Based on Firing

By Claude Witze

**Wheelus AFB, Libya**—Training program of the 701st Tactical Missile Wing includes the firing of 36 Martin TM-61 Matadors each year from a site 15 miles east of this base on the southern Mediterranean shore. The 701st is part of the 12th Air Force of USAFE (U. S. Air Forces, Europe.)

Conversion of the 701st's three groups from the TM-61A to the TM-61C was completed at the home bases in Germany early this year. There will be another transition in the future, to the TM-61B.

The B version will bring a bigger jump in performance and reliability. It is longer than its 39-ft. predecessors and has a shorter wing span. Presumably the speed will be greater than that of the A and C models—more than 650 mph. Ceiling is more than 35,000 ft.

### Self-Contained Guidance

Major advantage of the B is that it will carry a self-contained guidance system, requiring no ground control stations. Accuracy will be improved, while elimination of the guidance centers will lend new mobility to the 701st in the field.

In the first firing of the TM-61C witnessed by the press, target area for the Matador was about 250 mi. from the launching site, far short of the missile's range capability.

The "bird" landed in the desolate sands of the Libyan desert, where nomads and caravans were warned in advance of the 701st's intention to fire. Once the shoot is over there is a race among the natives to find the wreckage and salvage the metals.

Even at the launching pad, Libyan police patrol the area to keep local scavengers from fighting over the RATO (rocket assisted takeoff) bottle that drops from the Matador 600 to 800 yds. in front of the launcher. The RATO gives 52,000 lb. of thrust for two seconds.

### Training Program

Col. Robert Zachmann, deputy commander of the 701st., places emphasis on the fact that his men do not sit idle all year waiting for the AMLO (annual missile launching operation) to come along. There is a strenuous training program in Germany and the missile unit has taken part in a large number of NATO, USAFE and wing exercises.

The TM-61C carries both MSQ radar and Shanicle guidance systems, each of them requiring ground stations.

Primary means of communication is FM/UHF radio, with all of the equipment mounted on vans for mobility in the field. Wire circuits or landlines are secondary. They give better communication but would not be dependable in event of war. A third method of communication is HF radio.

These circuits provide the unit with point-to-point oral communication and teletype to missile operations centers and MSQ guidance sites. Other lines tie the groups to the wing for overall control.

All of the equipment at the Wheelus test was brought here from Germany in C-119 or C-124 aircraft, assembled on the transport vehicle and then moved to the launcher. The missile was shipped in four steel containers and one wooden crate, providing 2,745 cu. ft. of space. They weighed 20,000 lb.

Controllers of the 701st are trained in Germany with Lockheed T-33 jets containing the same kind of guidance system used in the Matador. During these simulated missile flights there is no conversation between the pilot and ground crews. All controlling is done by visual and audio signals.

The pilot knows if he is on or off the path by both a beep signal in the headset and from flashes by colored lights on the instrument panel. The ground controller is fully responsible for guiding the pilot correctly to the dump point.

### Missile Runs

There is a network of guidance stations in Germany and each T-33 is capable of performing two or three simulated missile runs on each sortie.

The 701st is composed of three Tactical Missile Groups. They are the 585th TMG at Bitburg, the 586th

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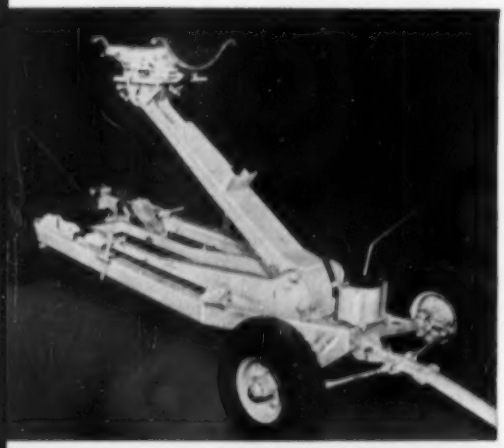

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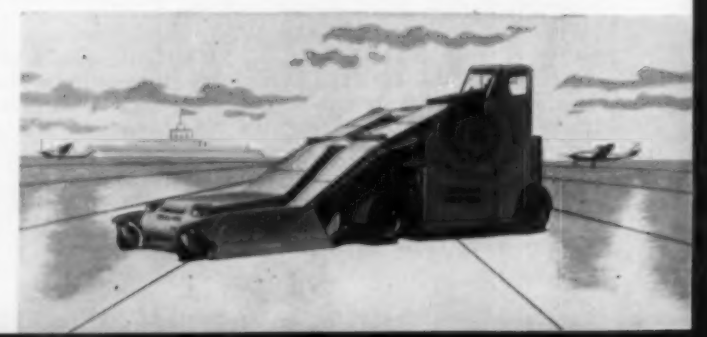


TMG at Hahan and the 587th TMG at Sembach, all bases in Germany.

Each group has three squadrons, a Tactical Missile Squadron, a Communications and Guidance Squadron and a Support Squadron to take care of the housekeeping. Each squadron has 12 launch terms and each team gets one opportunity each year to launch a Matador at the Wheelus range.

According to Col. Zachmann, the stern training program in both Germany and Libya is paying off in team proficiency. USAFE already is depending on the 701st for combat capability. During the Hungarian crisis of last November the squadrons were put on 24-hour alert and the control sites were manned around the clock.

## Instability Plagues 17th Air Force Area

**Wheelus AFB, Libya**—The Mediterranean is an ocean completely surrounded by the 17th Air Force.

With responsibilities that range from Northern Italy to North Africa and from Morocco to Turkey, the 17th covers a territory bigger than the United States. And it is an area plagued by political instability and economic insecurity.

There are the struggles for independence in Morocco, Tunisia and Algeria, the Suez situation, the tensions around Israel and the tinderbox of Cyprus.

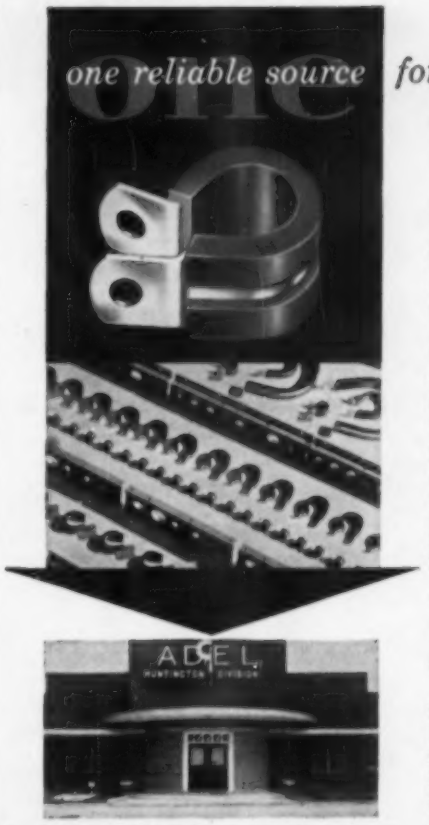
From 18th Air Force headquarters here at Wheelus, these things are complications that put unusual difficulties in the way of operations, threatening the security of installations and personnel.

Maj. Gen. Richard J. O'Keefe, commander of the 17th, probably is USAF's greatest expert on Arab affairs and he stresses the fact that he does not head a conquering or occupational force. The 17th, he says, is an invited guest.

The sheer mass of USAF's activity in this part of the world makes communications and logistics almost a more important part of General O'Keefe's job than pure defense. About 82% of the USAF officers and 46% of the airmen in the 17th's area are accompanied by their families. There are 3,200 high school and elementary school students attending base schools.

Yet with thousands of American women and children here in addition to USAF personnel, there has been only one USAF casualty that can be laid to the local uprisings. That was a case of mistaken identity.

Magnitude of the communications problem is pointed up by statistics. When the 17th was activated in 1953—it is the youngest Air Force—its entire area boasted fewer telephones than Brooklyn, N. Y., and 80% of these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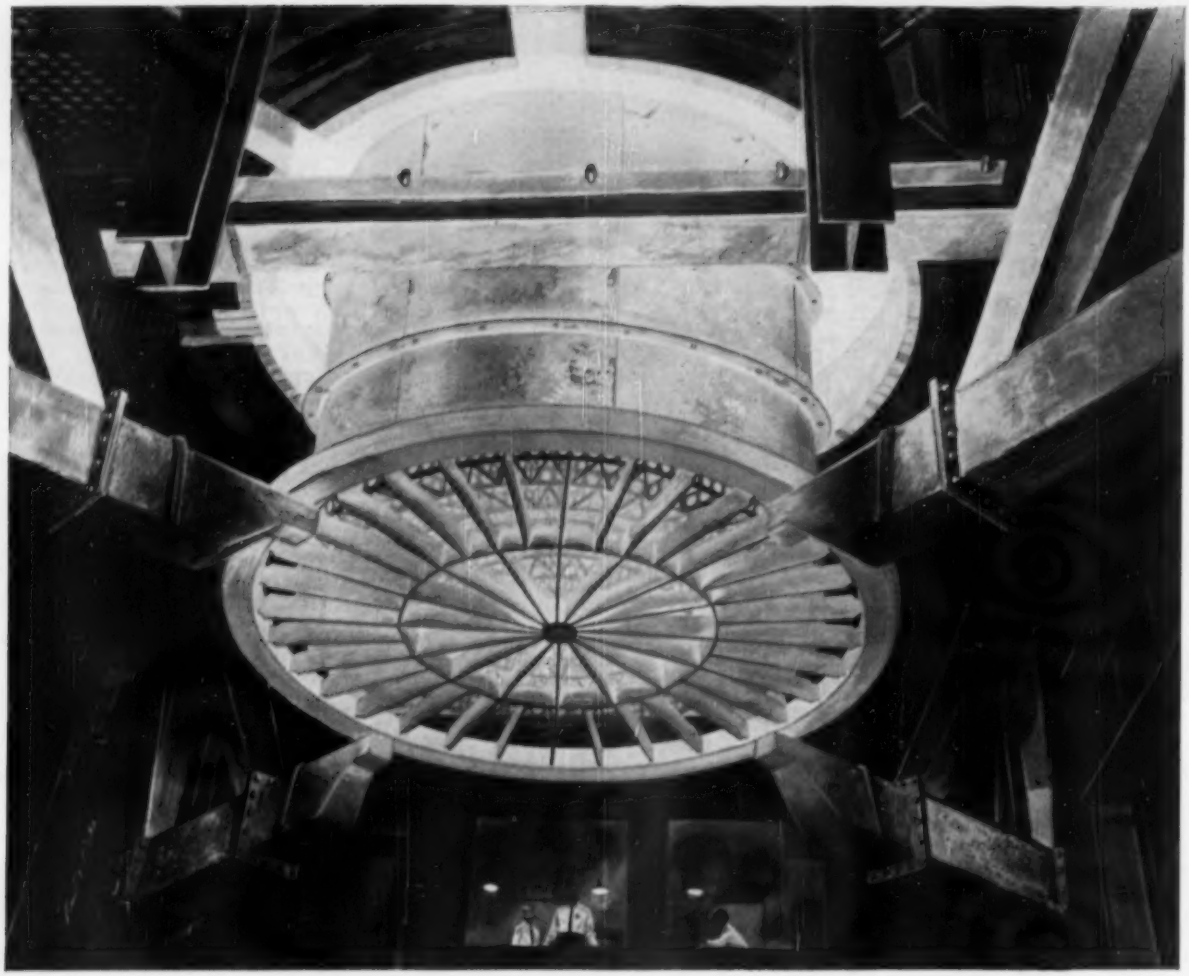

## *Solar Advanced Technology*

# All-metal honeycomb sandwiches solve aircraft heat, weight problems

Aircraft and missile designers continually increase their demands for lighter, heat-resistant materials. Solar technology is helping to solve this heat-weight problem with all-metal honeycomb sandwiches. The new product—called Solite®—is a strong, fatigue-resistant structure of foil-thin ribbons bonded between metal skins.

Large new electric furnaces were designed by Solar to braze these sandwich structures. Capable of operating at high temperatures with extreme purity of atmosphere, the furnaces incorporate many features which make them virtually unique.

Tailor-made for use in advanced aircraft and missiles, Solite offers a practical solution for exacting heat and weight requirements. For 30 years Solar has pioneered in welding and brazing high alloy steels that will stand up under extreme service conditions. Perhaps Solar can bring a fresh viewpoint to your difficult metal-working problems. Write Dept. D-63, Solar Aircraft Company, San Diego 12, California.

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were in Italy. The buildup to satisfy USAF needs amounted to a major accomplishment in communications engineering. The micro-wave network is finished and operating.

This network is vital to service far more than the spots where U. S. military units are physically located. They are in only five countries: Morocco, Lybia, Italy, Greece and Turkey. But the Air Logistics System operates over a wider range, with Baghdad, Beirut and Jidda as familiar to our pilots as LaGuardia and Washington National are to the airline crews back home.

## Radioactivity Used To Recover Rocket

Radioactive source—either two curies of Cobalt 60 or four curies of Antimony 124—is used in an Aerophysics Development Corp. hypersonic test vehicle to locate the vehicle for recovery after test flights.

Technique, developed by the Era Engineering Corp. of Santa Monica, Calif., is described as relatively simple and inexpensive. It has reduced previous three hour square search of a 10 sq. mi. area by light aircraft or helicopter to an average of 30 min.

In a typical test operation, the radioactive source is removed from its protective lead shield 10 min. before launching. Source is contained in an Allen screw one inch long and ⅜ in. diameter and weighing one or two ounces. Six foot aluminum rod fitted with magnetized Allen wrench is used to place source in the vehicle.

Impact point of vehicle is seldom observed exactly by radar or visually, but area is generally known within a square ten miles to a side. Using scintillometers, aircraft search the area by flying parallel grid lines 3,000 ft. apart until scintillometer detects the radioactive source.

Once located, the area is marked with flares and recovery crew picks up source in trailer containing the lead shield.

Cobalt 60, with a half life of 5.2 years and an effective lifetime of 20 years, was the first source used. Antimony 124, with a half life of 60 days and lifetime of eight months, was introduced to reduce hazard should a vehicle never be found.

Several of the vehicles in more than 40 test flights broke up in flight, but in every case the radioactive source and instrument package was located. Intensity of the radioactive source is not affected by high shocks of high accelerations encountered in flight. Its weight does not affect performance and the source does not effect avionic equipment, or for short periods of exposure, ordinary photographic film.


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Quality is Southwest's middle name, you know, so you do an extra good job on the cake, honey, and get out all the lumps. Those wise old-timers down there just don't compromise with safety or craftsmanship which, as any fool can plainly see, has helped make 'em grow so big . . . from a half dozen employees to more than 700, from 20,000 square feet of floor space to nearly 300,000, from zero volume to $8 million!

So put on your bonnet, button up your high-tops, and get a-goin' with that SAC cake, sweetie. Stick to the ridges and come right home.

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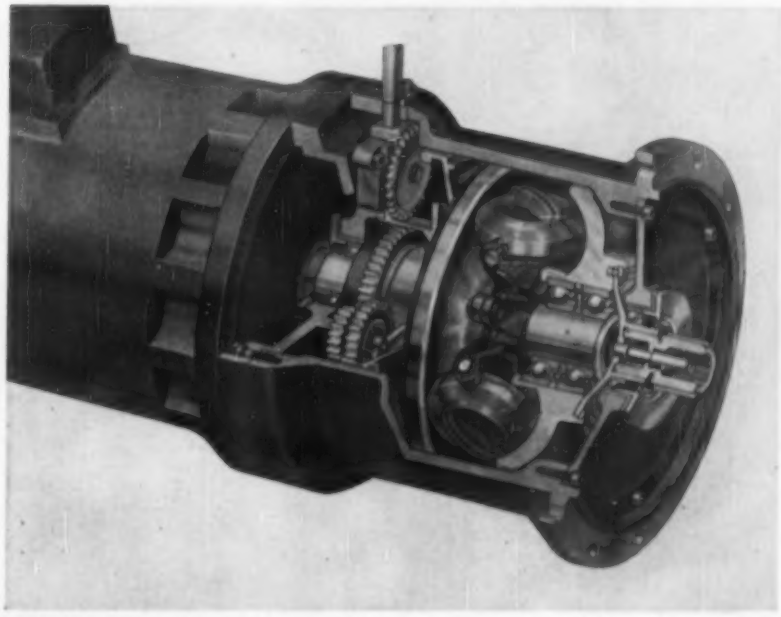
# Mechanical Drives Compete for Air Use

By Robert Cushman

New York—Air Force and Navy are encouraging development of mechanical constant speed drives for aircraft alternators as well as new versions of hydro-mechanical and pneumatic systems.

Specifically the services are watching with interest:

- **Lycoming** mechanical principle drive, two thirds supported by Navy funds. Navy reports encouraging results from performance of a prototype.
- **Axelson Division,** U.S. Industries, mechanical drive sponsored by USAF.
- **Hamilton Standard's** mechanical drive which the United Aircraft Corp. Division is developing independently at its St. Petersburg, Fla., research and development facility.



**LYCOMING** mechanical drive takes variable engine speed in at right and turns it into constant speed to drive the alternator, left. The 20 kva. unit weighs 50 lb.

### Mechanical Virtues

Advantage of mechanical drives versus hydraulic and pneumatic types is that mechanical drives offer higher transmission efficiencies over the hydraulic drives than hydraulic drives in turn offer over pneumatic drives. Joe R. Toth, alternator drive section, Navy BuAer, said that mechanical drives achieve transmission efficiencies up to 95-96% at peak loads and maintain 92% efficiencies at half loads.

Hydraulic drives may have peak load efficiencies in the order of 85% but their efficiencies fall to 75% at half load.

Another advantage of the mechanical drive, Toth said, is that it provides about the stiffest type of link between the large rotating mass of the aircraft engine and the generator. For this reason it resists effects of sudden changes in electrical loads better than the other types of drives. A possible disadvantage could be rapid progressive failure in certain cases.

Lycoming's mechanical drive has caused wide interest among the airframe industry, Toth said. This could be due to the fact that Lycoming has already completed an unofficial MIL-T-7101A qualification test.

For its part, Lycoming claims its present 20 kva. mechanical drive is smaller in size, lighter in weight than any other available mechanical, hydrokinetic or hydraulic drive with comparable speed flexibility. It claims that the efficiency will be 92-95% over the full operating range.

Arthur Nutt, vice president-engineering, Lycoming, told AVIATION WEEK that because the contact loadings used in the drive are less than those normally used in bearings, the simple mechanical approach should result in improved reliability. This is an important element in any alternator drive since alternator power systems are being called upon to supply an increasingly critical portion of aircraft "secondary" power.

After development and tooling costs are amortized, the new drive might also prove less expensive, Nutt added.

### Known Principles

All three of the new mechanical drives are based upon principles which have been well known for over fifty years.

Essentially they are devices that vary the diameter of the input-output shaft linkage. The Axelson drive uses a concave cone and roller arrangement, the Lycoming drive uses intermediate roller-wheels between two special shaped disks and the Hamilton-Standard drive is based upon the Swiss patent upon which New Departure based its Transitorque automotive transmission (AW May 6, p. 23).

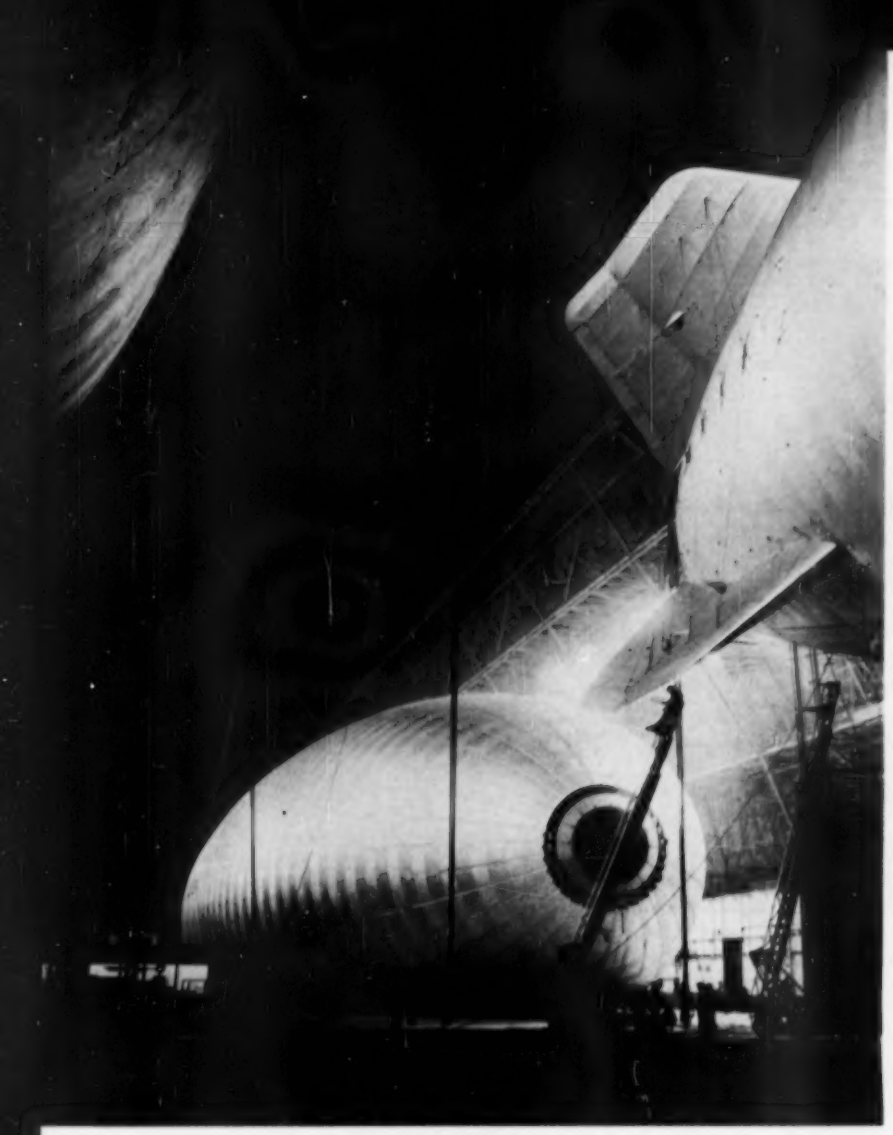
The reason that these principles have not been successfully applied to constant speed aircraft alternator drives in the past, though they have been used industrially, is that for aircraft, they demanded materials and finishes which were unobtainable. It was not until present high temperature stabilized steels were available that the known principles could be refined and packaged into an aircraft drive.

The C-O-S (constant output speed) drive, as Lycoming calls its product, uses the intermediate roller-wheels to take power off one diameter (and therefore at one speed) off the input side and transfer it to another diameter (and speed) on the output side, according to their angle. Doughnut or toroid grooves are scooped out of each disk to take the wheels so that the drive contact forces are counterbalanced radially and there is no tendency for the wheels to be forced out away from the disks.

The input and output disks each are carried on their own bearings on a short shaft, a special twisted bolt through the center of which clamps the two disks in against the roller-wheels. Lycoming says that the disks are purposely given their own mountings so that drive loads will not be transmitted to the housing. This also eliminates misalignment problems due to thermal expansions.

The tilting of the roller-wheels is accomplished by the dynamic reactions inherent in the spinning roller wheels in the toroid races rather than plain mechanical force.

A ring just inside the housing has



## Big Blimp at Akron

**Navy's ZPG-3W non-rigid airship (AW June 10, p. 88) is under construction in Goodyear Aircraft Corp., Akron, Ohio airship dock. Described as the largest ever built, the blimp will cost about $4 million. Volume is 1.5 million cu. ft., about one and a half times that of the ZPG-2W now in Navy early warning service.**

pins which project inward to engage diagonal cam slots on the outer surfaces of the roller wheels. When the ring is rotated to change the speed ratio, the pins try to tilt the roller wheels sideways. But because the wheels are spinning, their gyroscopic action causes them to precess and tilt in the correct direction. Once this action has started the shape of the toroid raceways in which the wheels are rolling steers the wheels to the tilt angle called for. Thus by taking full advantage of the dynamics of the situation, light primary control forces are used to create a rapid response despite the inertial forces involved.

The result of this stiffness and rapid control response, according to Lycoming, is that if a shock load equal to the normal rated power is applied, it will cause less than a 4% frequency deviation which will be reduced to less than ½% in 0.6 seconds and less than ¼% in one second.

The external controls which govern the drive's speed are composed of a tuning fork 400 cps. reference frequency and a magnetic-transistor amplifier. Lycoming is now in the process of packaging this portion of the drive.

For high speed aircraft potential efficiency of mechanical drives has twofold attractions. Not only would the efficiency save precious fuel, but lesser amounts of waste heat rejected in the vicinity of the alternator eases the cooling problem (which becomes acute when the ram air must be refrigerated before it can be used). These factors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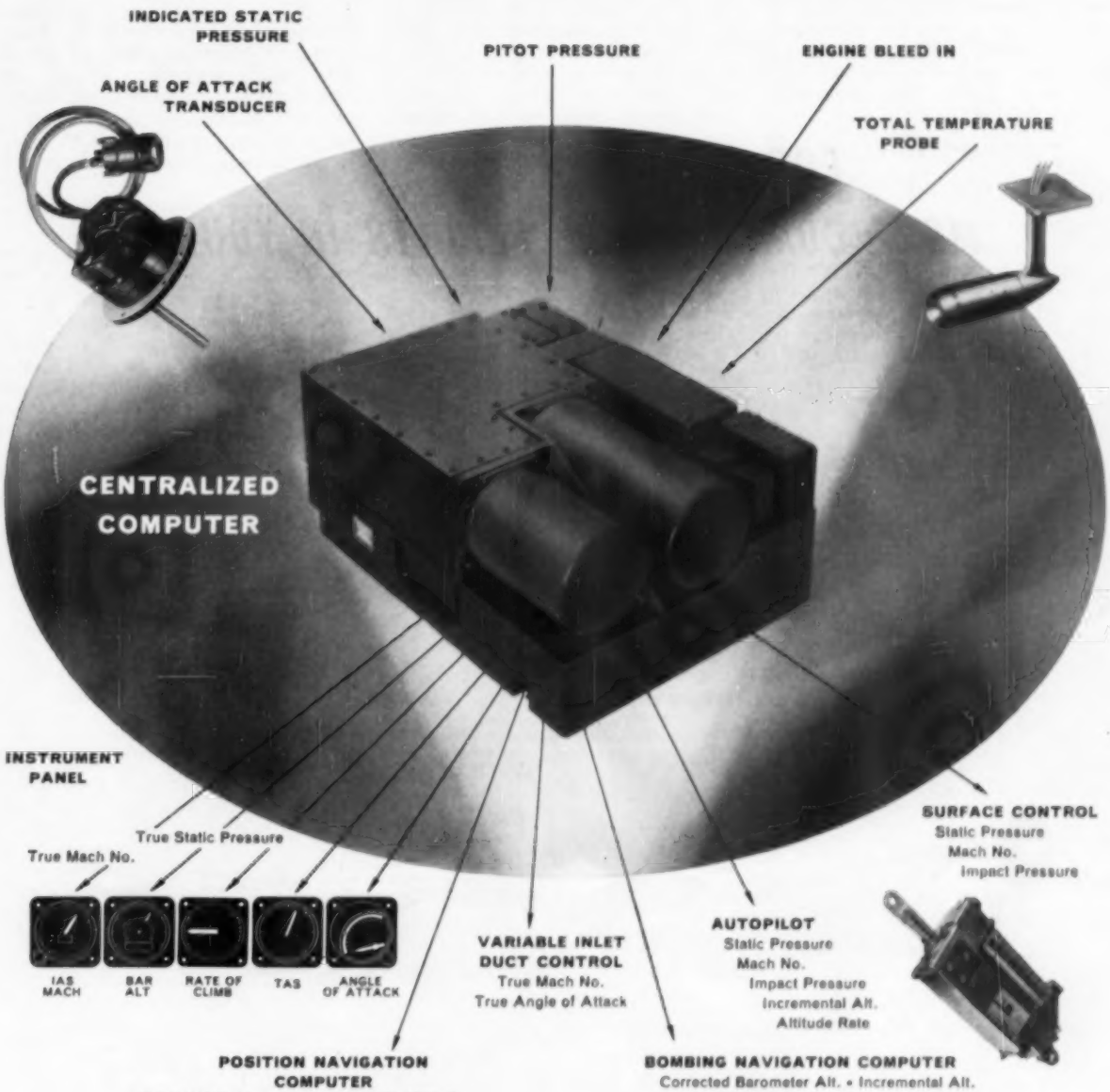


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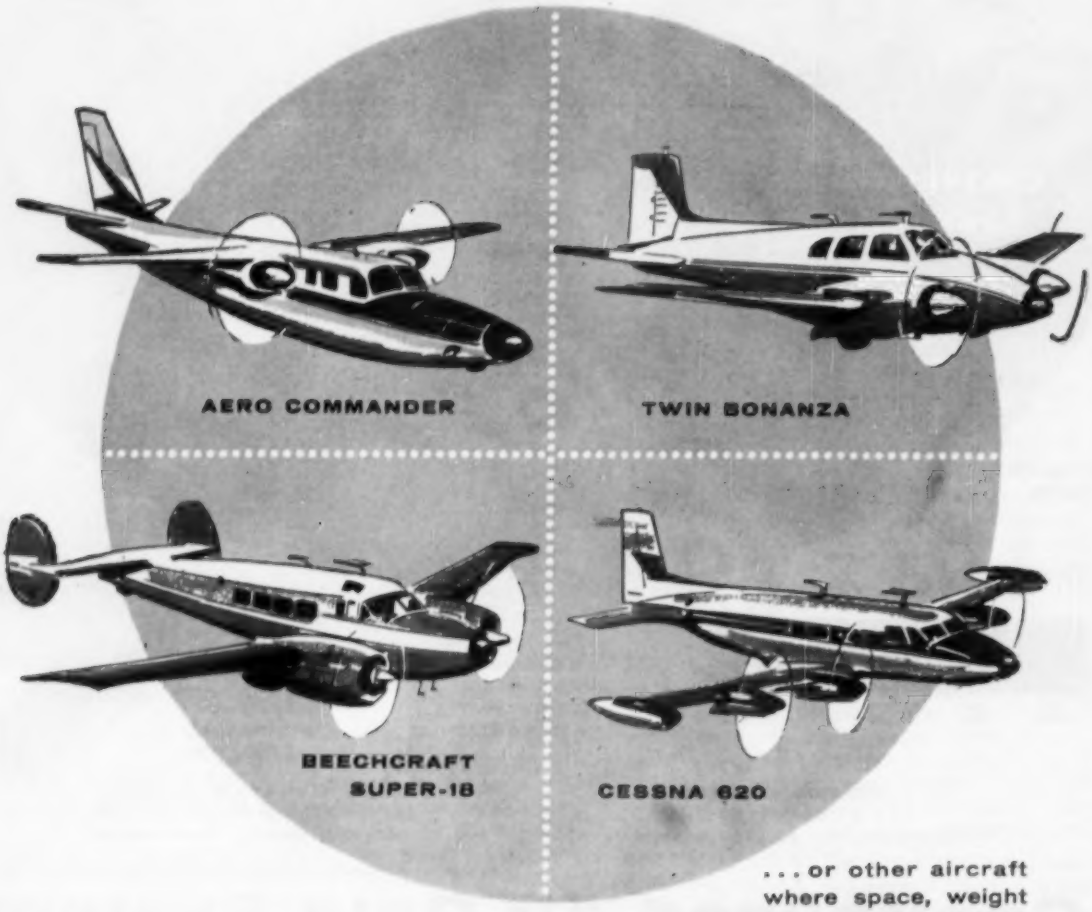


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combined with the present 350F ambient operating temperature capability of the Lycoming drive help to explain the Navy's enthusiasm, Toth said. While the operation of most known hydraudic drives is seriously curtailed above 300F, Lycoming is confident that it can push its mechanical drives to 500F.

The initial size of the Lycoming drive is 20 kva. Future drives will be as big as 120 kva. The 20 kva. drive will weigh just over 50 lb.

The Axelson "A-Drive" is similar to the Lycoming drive in that it also uses three rollers tilting between two disks. However in the Axelson drive the rollers ride in the saddle formed by the two concave cone shaped disks rather than grooves cut out of the disk faces. Also the drive differs by relying on direct mechanical force to tilt the rollers rather than gyroscopic action.

The Axelson drive was recently qualified by USAF at Wright Field for 40 kva. use, according to Axelson's H. V. Jacobsen. At Axelson's laboratory, a 500 hr. endurance test was successfully passed and the drive's ability to perform satisfactorily in environmental conditions of 50,000 ft. altitude and extreme temperatures despite 100% overloads was demonstrated.

Navy and USAF also are interested in new approaches to hydraulic constant speed drives. A Pentagon spokesman explained this as partially due to government reluctance to be limited to a single source.

To date the services have been relying on Sundstrand as a single source of alternator drives. (There have been others but the largest share of the business has gone to Sundstrand.) As a result, the spokesman pointed out, there is constant pressure from government purchasing sources to encourage competition in the field.

One new hydraulic approach, selected by Stratos Division, Fairchild Engine and Airplane Corp. though it has not received any financial support, is considered promising for Navy purposes. It is based upon a German patent and is similar to that of the well known Sundstrand drive in that the hydraulic portion is arranged to overdrive or underdrive a mechanical drive whenever the input speed falls below or above a certain median speed. While the Sundstrand drive is said to use a spur gear arrangement to achieve the differential effect, the Stratos and Vickers drives use epicyclic gearing.

The catch to purely mechanical drives, said a Stratos engineer, is that if they ever do slip, the subsequent galling of the contact surfaces would cause rapid progressive failure.

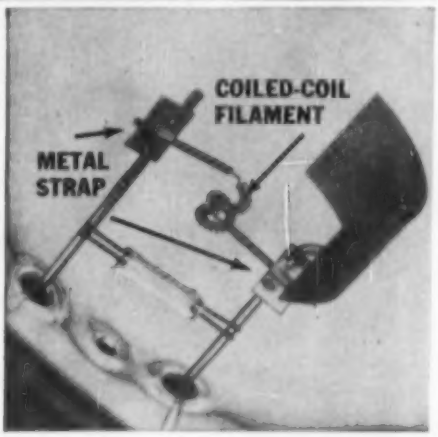
Pneumatic alternator drives are not being overlooked either. Despite the wariness towards pneumatics by one USAF using command (AW June 24, p. 81) advance weapons planners are aware that nothing but pneumatics may be feasible in future ramjet and rocket aircraft, since in these aircraft there may be no rotating powerplant elements from which to extract mechanical power directly. However, for the sake of efficiency, there seems to be a swing in interest from "cold" compressor bleed pneumatics to "hot" combustion gases systems.

One engineer contacted by AVIATION WEEK summed up the industry side of this interest in constant speed drives by saying that it is possible that by 1960, if the swing to missiles (or ramjets) doesn't completely upset manned aircraft trends, the demand for constant speed drives will amount to $100 million per year.

## Solar Will Supply Turbine Generators

Air Materiel Command has awarded Solar Aircraft Co., San Diego, a $1,384,000 supplementary contract for gas turbine powered airborne generators. Sets will be powered by Solar's 50 hp. Mars gas turbine engine and will be installed in the Boeing KC-97 tanker.


G-E 600-watt Landing Lamp has...

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For more information on General Electric Landing Lamps, or any of the other General Electric Aircraft Lamps, call your G-E Lamp Distributor, or write: General Electric Co., Miniature Lamp Dept. AW-87, Nela Park, Cleveland 12, Ohio.

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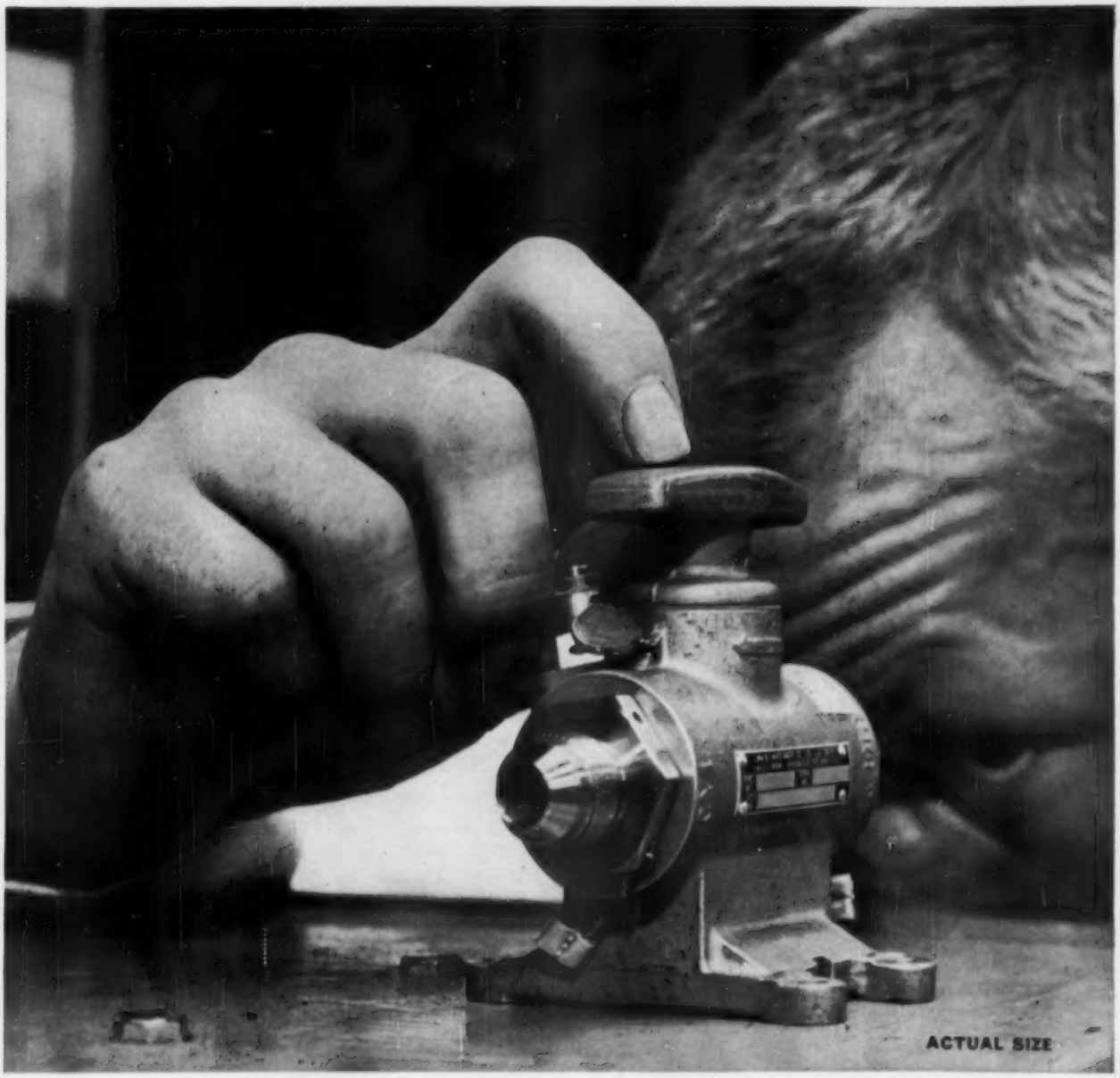


**Extremely low pressure drop is the striking feature of this new Whittaker valve. This is made possible by mating a rotary plug to a sleeve thus providing straight-through flow. Valve shown is equipped with thermal relief valve that is vented to the pressure port to relieve thermal pressure at the downstream port. This eliminates need of drain port or vent.**

New Whittaker Rotary Shut Off Valve is now in use as emergency landing gear shut off unit in Lockheed Electra.

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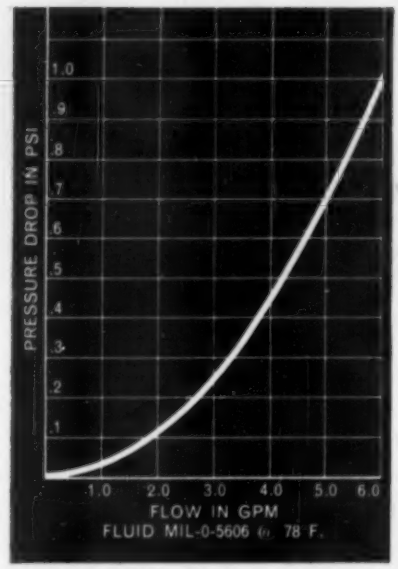
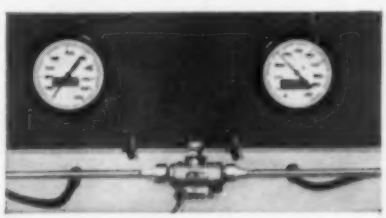



At 3000 PSI, leakage is only two drops per minute, because the pressure is used to seal the already close clearance of the mated plug and sleeve.



Here is a remarkable achievement in valve design—a design suitable for any type of shut off application!

No valve so small and light has ever incorporated all the features of low pressure drop, minimum leakage, plus straight-through flow—attained by incorporating a rotary plug that is mated to a sleeve. The valve is smaller than comparable units of this type.

Although the customer's specification called for a maximum torque of 45 in/lbs. Whittaker tests showed torque ranging down to about 20 in/lbs. Since the valve lends itself so well to motor actuation, this low torque permits the use of smaller motors and less power.

This valve is available with or without thermal relief. It is typical of the many contributions Whittaker has made in hydraulics—innovations available to you in quantity *now!*

CLOSED POSITION
(HANDLE ROTATED 90° CLOCKWISE)

OPEN POSITION

## PERFORMANCE

SERVICE FLUID: MIL 0-5606
(Similar units suitable for other fluids and pneumatic service.)
WEIGHT: 10 Ozs.
(with thermal relief, 1.1 lbs.)
TEMPERATURE:
Ambient, −65°F to +160°F.
Fluid, −65°F to +160°F.
(with appr. "0" rings to 275°F.)
PRESSURE: 3000 PSI (proof 4500 PSI—burst 7500 PSI)
RATED FLOW: 6 GPM
PORT SIZES: ¼", ⅜" and ½".

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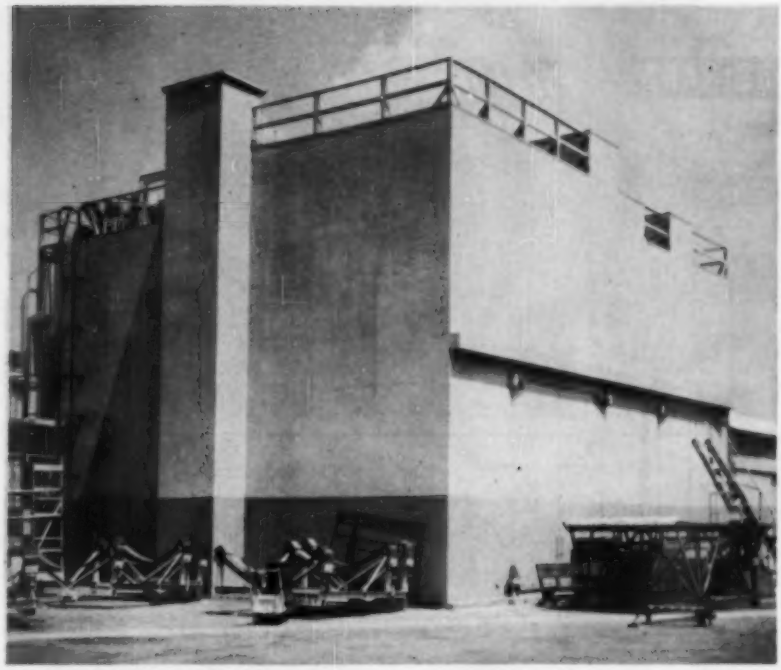


**SOUND LABORATORY** which Douglas aircraft will use to determine a measure of passenger annoyance due to noise includes audition room, anechoic chamber and various other test rooms. Cost of building was $500,000.

# Laboratory Seeks Sound Index

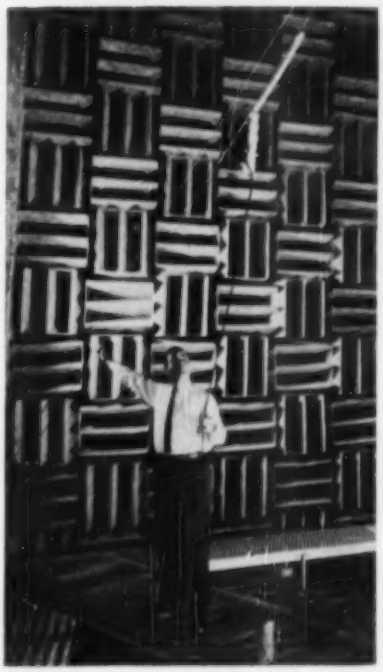
**Santa Monica, Calif.**—Acoustical Comfort Index for turbojet airliners will be devised by Douglas Aircraft as a realistic unit of measure of passenger annoyance due to noise. Project will make use of company's new $500,000 sound laboratory.

Douglas has used an ACI for propeller driven aircraft for about six years but usefulness of measure requires that it be applied only to sounds of comparable characteristics and composition.

Frequently used measure of annoyance caused by a sound is the degree to which it interferes with normal speech. But a Douglas engineer points out that an orchestra can interfere with speech without being annoying.

Jet noise spectrum can be reproduced in Douglas facilities and means of filtering and insulating it can be analyzed for their effect on passenger comfort. Human subjects will be used to determine effect of different combinations of pitch, intensity and frequency distribution.

Laboratory consists of an audition room, anechoic chamber, reverbration room, siren fatigue test room and analysis room. Fatigue test room will check the effect of the jet noise spectrum on structures. Facilities are also available to study effects on avionic components.



**ENGINEER** is placing various test equipment in the anechoic chamber of the new Douglas Aircraft sound laboratory. Convair also has built such a chamber for determining jet noise effects as related to the comfort of passengers.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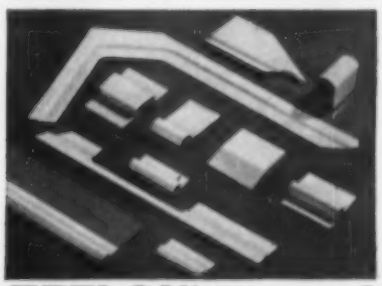


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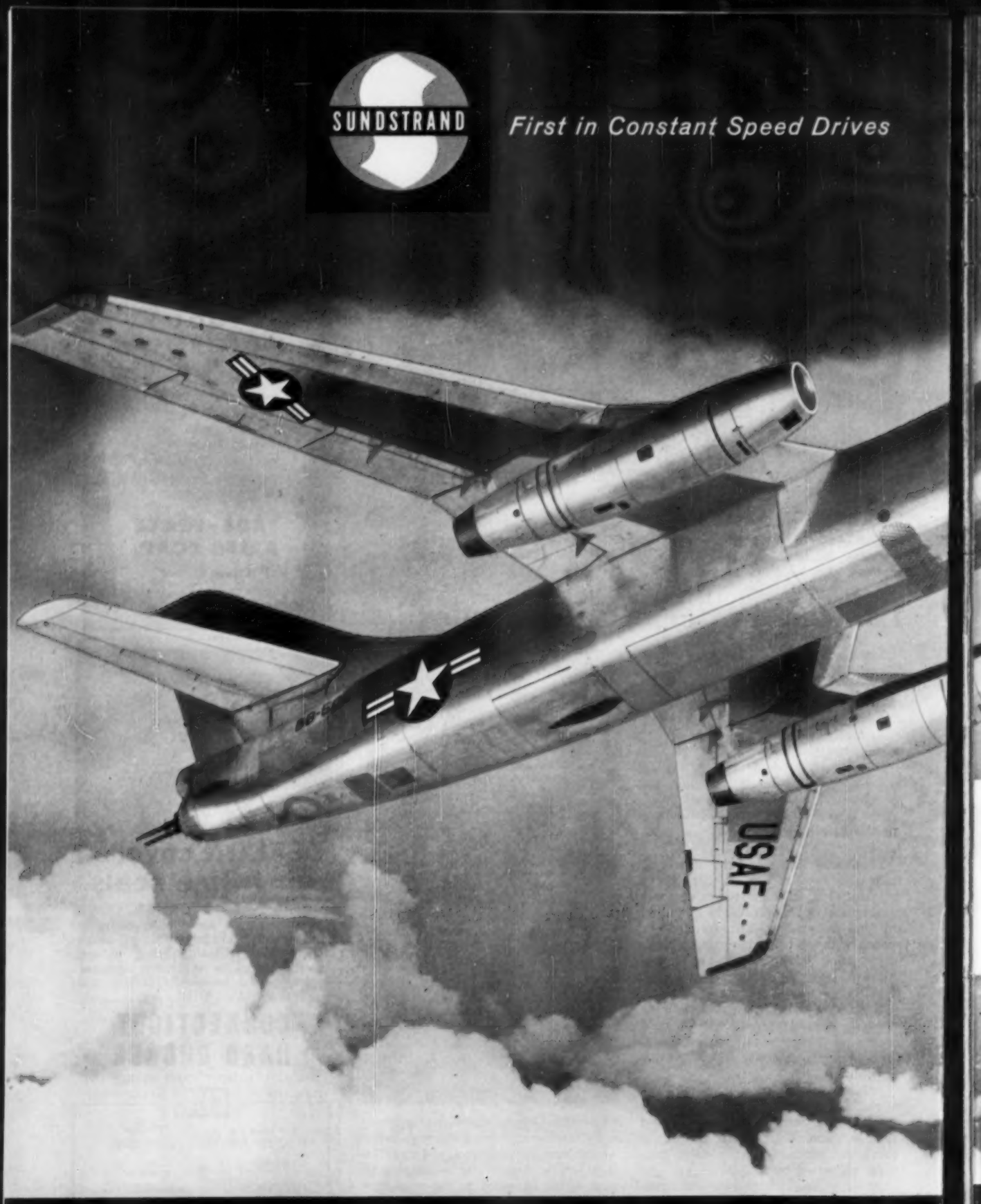
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First in Constant Speed Drives
USAF...

# SUNDSTRAND DRIVES

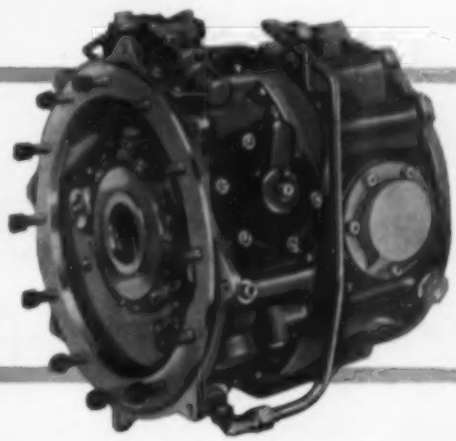
## Provide Trouble-free Constant Frequency a-c System for RB-66

More than 30,000 flight hours in Douglas B-66 and RB-66 Destroyers—that's the current service record for Sundstrand Constant Speed Drives. During this time the Destroyer's 400-cycle electrical system has proved itself to be virtually trouble-free—a necessity for all-weather, around-the-clock photographic, mapping, and bombing missions. Two Sundstrand Drives power the Destroyer's electrical system, each alternator supplying a split bus. Automatic paralleling is possible when desired with the equipment installed, but optimum performance is assured whether alternators operate singly or in parallel. The extremely compact and lightweight installation has its oil system integrated with the engine lube oil system.

Service experience with the Destroyer is another example of the record for *reliability* and *performance* that has made Sundstrand *first* in constant speed drives.

### WIDE RANGE OF MODELS

The "Sandwich-Type" Sundstrand Drive mounts on engine in nose cone, supports alternator on its output pad. It uses engine oil ported through the pad so there are no external oil connections between engine and drive. More than 20 different models of Sundstrand Drives have been installed in virtually every major type of aircraft.



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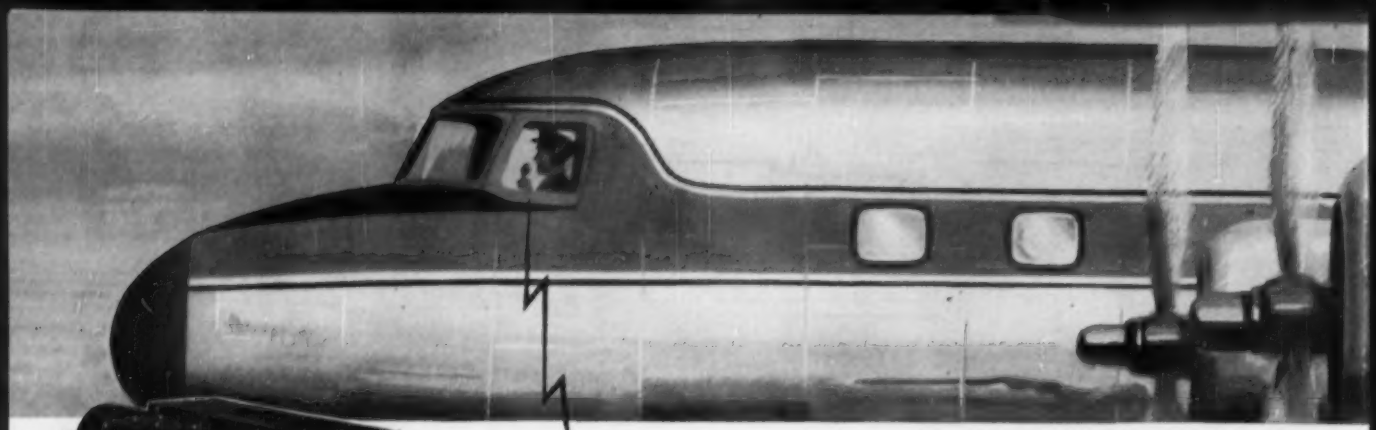

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Each provides 360 crystal-controlled channels from 118.0 to 135.95 megacycles with 50 kilocycle channel spacing. Receiver: 3-microvolt sensitivity with carrier-operated squelch control. Transmitter: 25 watts minimum of r-f output power.

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**RG-9 RECEIVER, TG-19 TRANSMITTER**

Receiver: 118.0 to 135.9 megacycles. Single-channel operation with 50 kc channel separation. Transmitter: 108.0 to 135.9 megacycles. 50 watts r-f output power. Single channel with facilities for dual channel operation on output frequencies within 800 kc.

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The complete system consists of the RA-18 and TA-20 Airborne Receiver and Transmitter; and the RG-9 and TG-19 Ground Station Receiver and Transmitter. *Combined weight of the airborne units including power supplies is 49 lbs.*

TO DATE, 80% OF THE AIRLINES THAT HAVE CHANGED TO 360-CHANNEL OPERATION HAVE SPECIFIED BENDIX RA-18 RECEIVERS.

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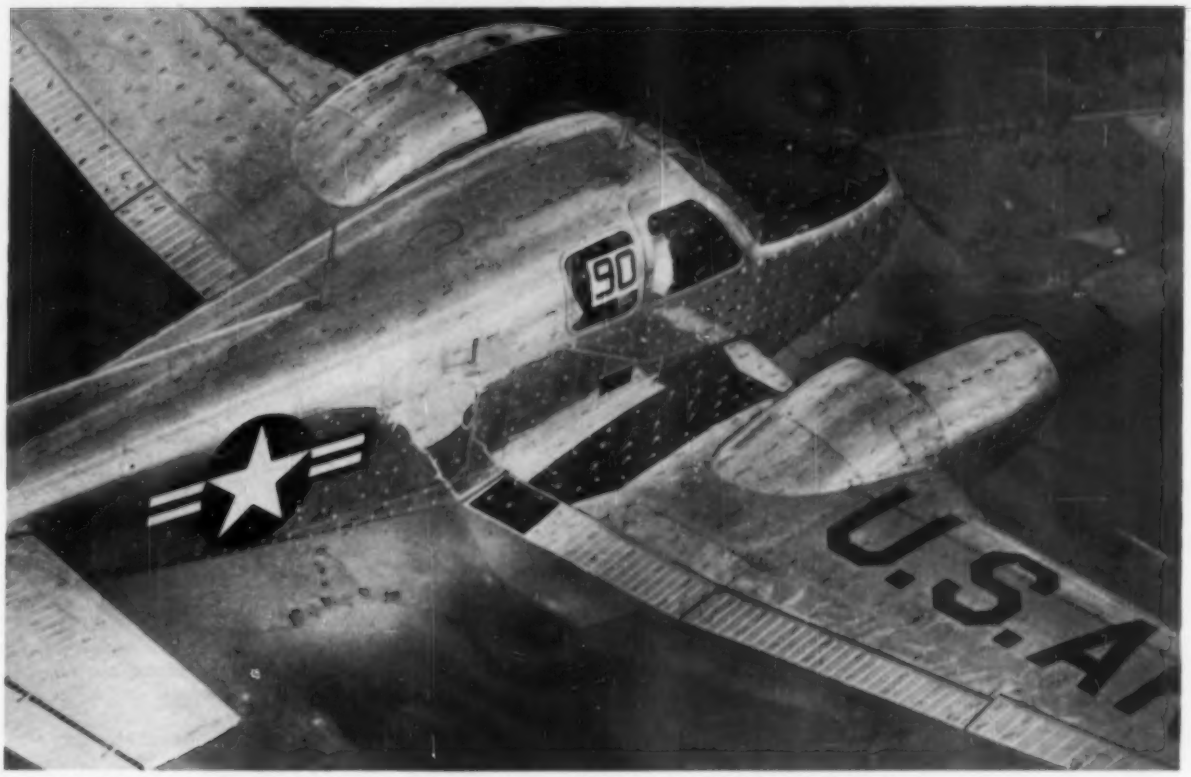



**ORIGINAL YL-23** prior to geometric boundary layer control modifications is fully tufted to locate flow breakaway areas.

# Performance Jumps in Cleaned-Up YL-23

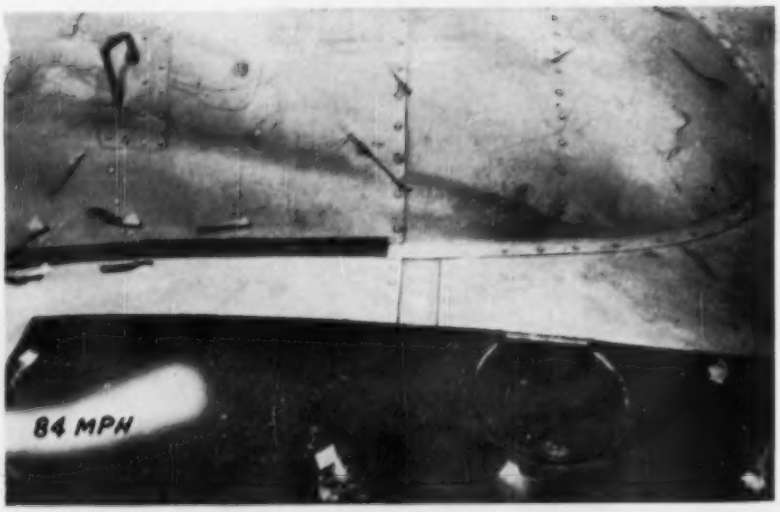
Major performance gains are possible on conventional business aircraft configurations by applying classic rules of geometric boundary layer control, a detailed study of a typical light twin completed recently by the Aerophysics Department of Mississippi State College reveals.

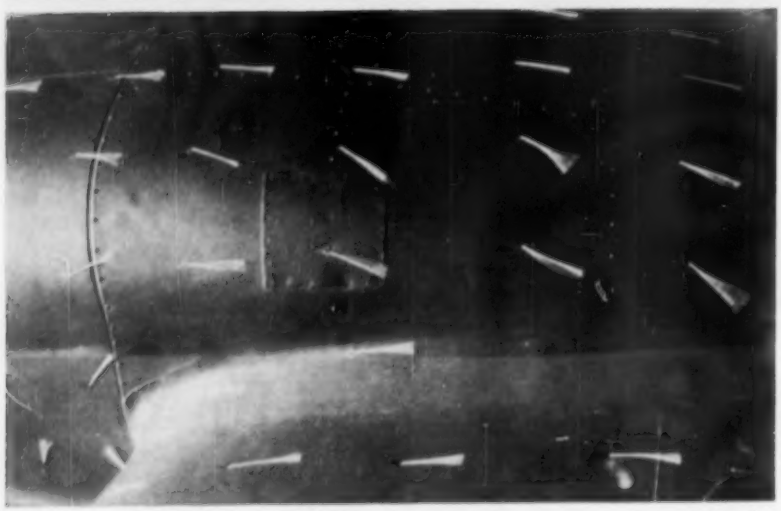
Under direction of Dr. August Raspet, well-known low-drag proponent, the department modified a Beech YL-23 Twin-Bonanza loaned by the U.S. Army, cleaning up the airplane's exterior to evaluate application of geometric boundary layer control on a modern light twin. Extensive flight tests of the modified configuration showed:

- **Approximate 20% reduction** in power required at nearly all airspeeds.
- **Reduction of 14%** in effective parasite drag coefficient.
- **Increase of 8%** in span efficiency.

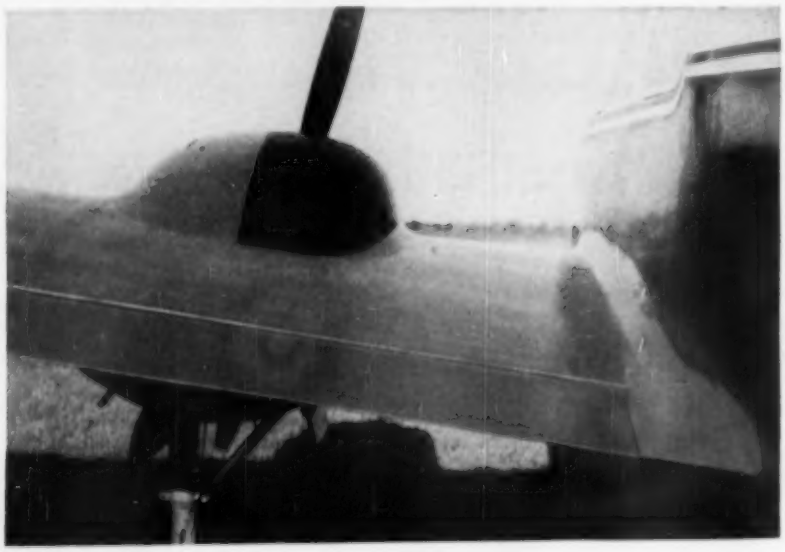
There was also a slight increase in

**MODIFIED YL-23** has dorsal fin removed, external antennas, wing root fairing and smoothed tail surfaces to reduce drag.



**ORIGINAL NACELLE** (top) experienced flow reversal with stream separation at 90 mph.; area continued to grow until it was complete at 84 mph. Propeller is feathered. Just below is modified nacelle taken at 75 mph. airspeed, separation was avoided to 72 mph. Faired nacelle and wing root is detailed in bottom photo of modified YL-23.



propulsive efficiency. These factors together provide these marked improvements in performance:

- 28% **increase** in range,
- 10% **increase** in maximum speed,
- 30% **gain** in endurance.

Short-field characteristics were also apparent, the test pilot reported.

YL-23 used by Dr. Raspet was a good vehicle for his observations and modification, having been delivered to the Army as one of several hand-built prototypes for service test and having accumulated considerable flight time before it arrived at Mississippi State College. Finish represented the period prior to production experience wherein the learning curve rises to make for more efficient finished product with optimum "polish"—rough service life provided an accumulation of dents and flat spots, distorted access panels and other components all tending to mar the original aerodynamic configuration sufficiently to provide obvious references for study.

These factors, in addition to characteristics of the general design configuration evaluated by Dr. Raspet prior to his modification program embodying geometric boundary layer control philosophies, provided a study vehicle offering many broad across-the-board pointers to light aircraft designers.

## YL-23 Critique

External visual inspection of the YL-23's general aerodynamic condition by Dr. Raspet's group prior to modification showed these characteristics:

- **Wings.**

These were comparatively good for production components in that flush riveting was extensively used and contour of leading edges was kept to reasonable tolerances.

Inspection access panels fitted poorly, the report notes, and in service they had become distorted so that they were sources of aerodynamic leaks or high drag. Auxiliary fuel tank cap cover and scupper access door were located in a high velocity region and were sources of aerodynamic leaks. In flight the cap cover lifted sufficiently to become a very effective spoiler. Scupper drain was located in a comparatively higher pressure region and, according to the report, may contribute the necessary internal pressure initially to lift the cap covers into the flow.

Although the wing leading edge is well contoured, many of the countersunk rivets were either protruding into the airflow or in process of being countersunk had their holes elongated, resulting in skin roughness. Where dimpled rivets were used, several flat spots or depressions were noted.

As the wing contour approached the spar, a noticeable flat spot was en-

## FLY WEATHER-WISE — Mobil

These weather items prepared in consultation with the United States Weather Bureau

# TEMPERATURE VARIATIONS

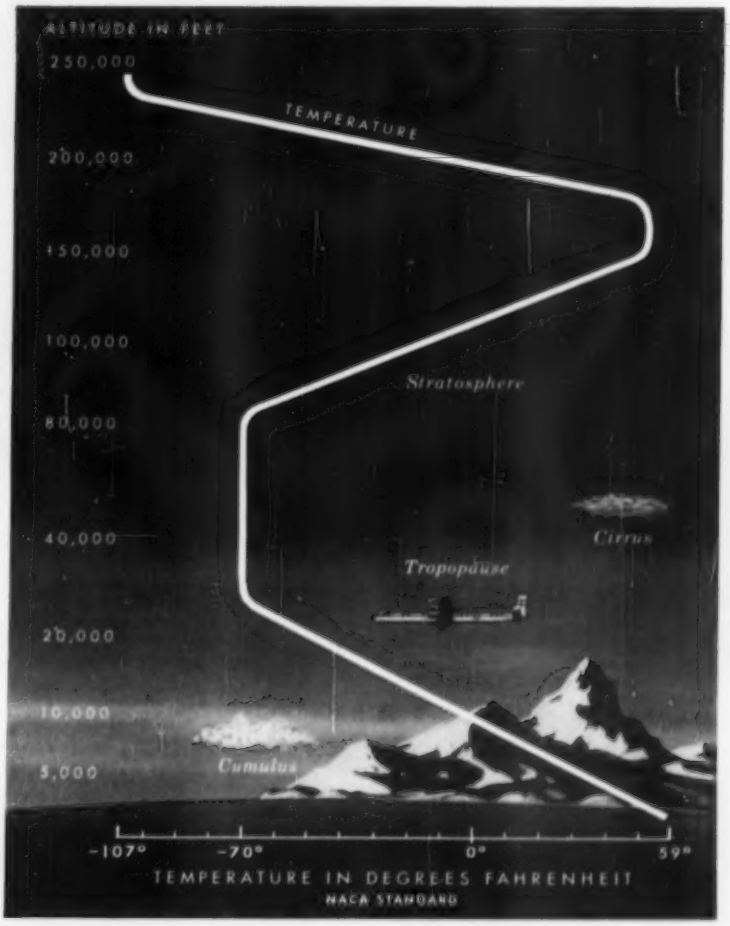
## IN RELATION TO ALTITUDE...

TEMPERATURES encountered in a single flight may vary as much as 130°F. or more. These variations are associated with altitude and weather patterns and can affect flight performance.

**Temperature and altitude**—Heat from the earth warms the atmosphere with steadily decreasing effect as altitude increases. Temperature normally decreases with altitude at the rate of 3½°F. per 1000 ft. At the tropopause (top of troposphere) temperature remains almost constant up to 80,000 ft. Therefore, modern aircraft encounter coldest air in the tropopause layer which varies from about 28,000 ft. in the polar air masses to 54,000 ft. in the tropical.

As altitude increases from approximately 80,000 ft. to 150,000 ft., the temperature returns to almost sea level condition. This is the result of strong absorption of the sun's ultra-violet rays in the layer of ozone gas at very high altitudes.

At still higher altitudes, the temperature reverts to extreme cold.

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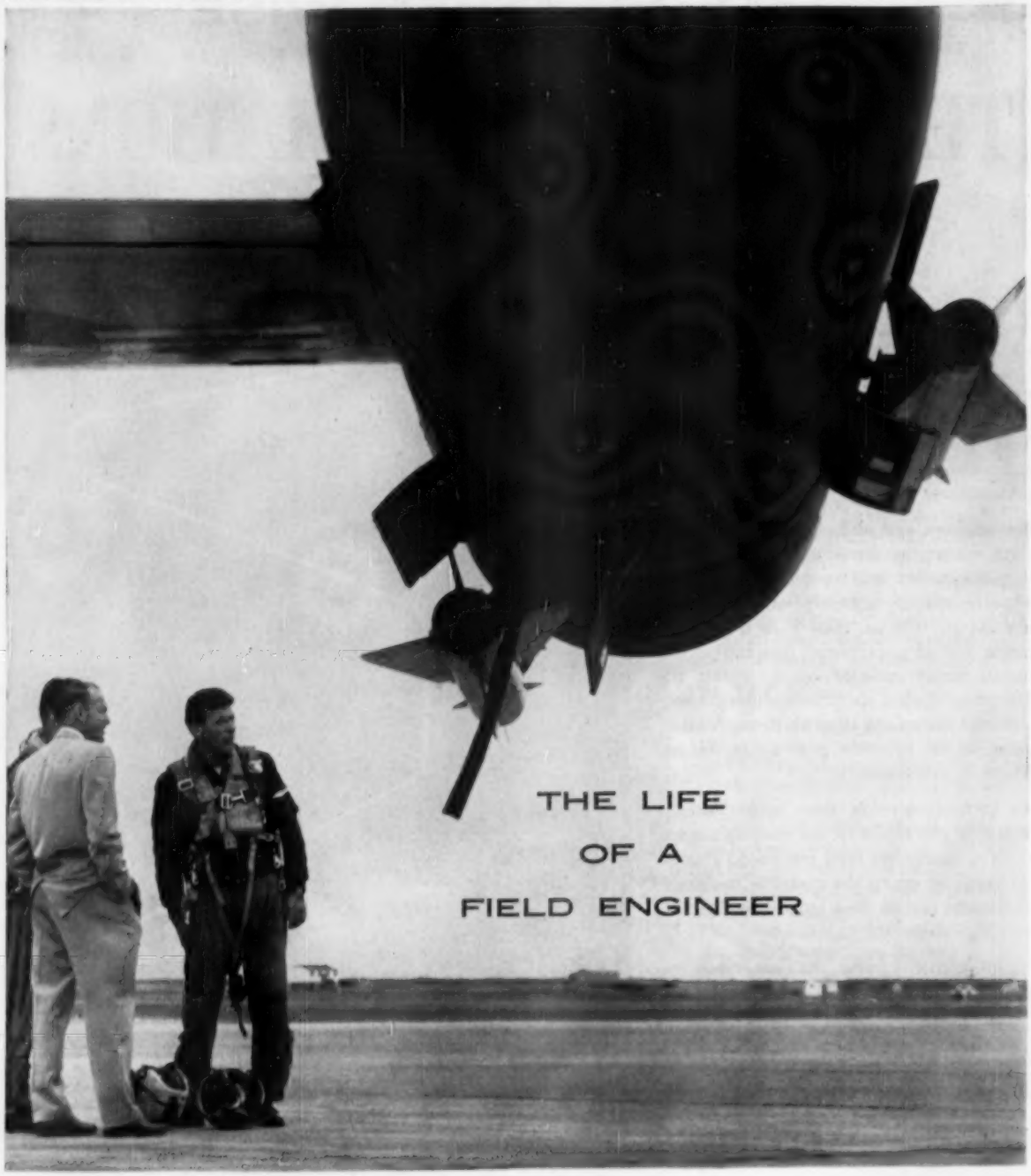


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countered and immediately after the spar there was a contour reversal followed by a sharp break onto the spar. This geometry was sharply reversed aft of the spar.

Under the wing there was a series of straight sections that make abrupt turns at each stringer to form the lower surface.

Underneath the inboard section, there were numerous protuberances such as brazier rivets, drains, vents and badly fitted access doors.

### Landing Light

Landing light installation was rough, the report notes, and was located in a critical high velocity region. Wing fitting access panels extended into the flow.

Leading edge skin on the left wing did not fit the spar and resulted in a leak in a critical position, the outboard section of the upper surface.

The wings did not have any root fairings.

Gaps between tab on the aileron, between outboard and inboard flaps and between flaps and fuselage were noted. Ridged flaps and ailerons are probably a high drag source, particularly in event of sparswise flow; even normal chordwise flow suffers some drag penalty, the report concludes.

• **Engine nacelles.**

Nacelles seal well and are comparatively smooth. Major area for improving airflow is in the landing gear wells; the semi-retracted gear was located in a high velocity region and wheels and doors were not sealed. Vacuum pump vent and oil vent were located in a high velocity region atop the nacelle.

Oil filler cap access door is distorted and lifts in flight.

Geometry of the engine nacelle above the wings is not completely satisfactory, the report states. Oil streaks indicated that this contributed to spanwise flow over the inboard area of the wings.

Raspet's report notes extensive number of vents for engine and accessories. There are 13 external vents, drains and the like on each wing and nacelle to take care of the two fuel cells and single engine in this area.

• **Fuselage.**

This showed the most promising area for geometric boundary layer control application, according to the report.

Fiberglas nose piece and fasteners were sufficiently rough to cause turbulent flow almost immediately.

Retracted nosewheel and doors were unsealed. Underside of the fuselage is rough, the report found, including lap joints, vents, drains, access doors and high-drag antennas.

Baggage door and cabin door fit apparently permitted a large volume of airflow into the boundary layer on the right side of the fuselage.

Requirement for a dorsal fin and its effectiveness needed to be investigated; the Raspet group felt that its estimated 10 sq. ft. of wetted area could possibly be eliminated.

### Added Noise

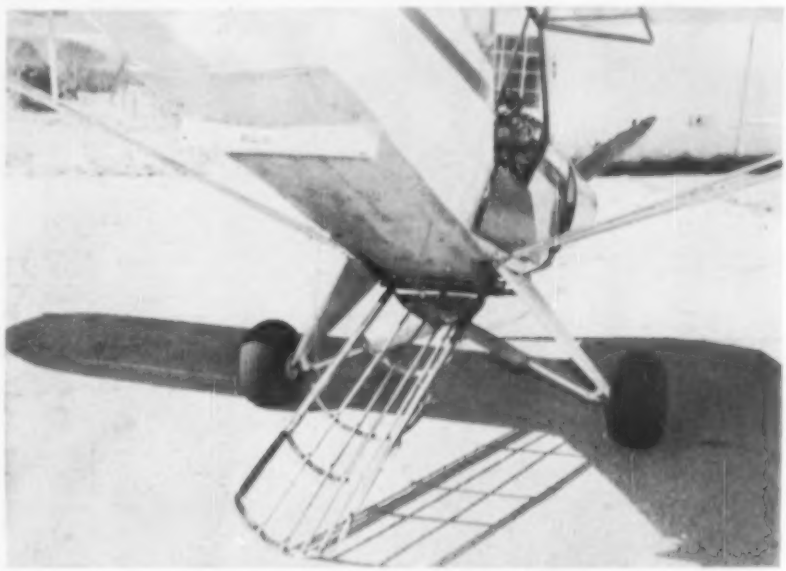
In addition to unsmooth joints around the cabin windshield contributing to drag, they also provided a source of high-frequency cabin noise, the report added.

Omni and glide path antennas are located in a high-velocity region well forward on the fuselage.

High-drag antenna vibration could also be a source of cabin noise, the report said.

• **Empennage.**

Here were found several drag sources, including roughness aft of the dorsal fin, the report stated. Immediately aft of the leading edge there was a spanwise row of closely spaced brazier rivets. Airfoil aft of the leading edge is formed by two concave surfaces ahead of the



## Airplane Speeds Fencing Job

**Homebuilt "basket" fitted underneath Piper Super Cub made possible airlift of 600 fence posts and needed barbed wire in 10 hr. flight time in remote area of New Mexico. U. S. Forest Service, responsible for erecting the fencing, estimates that the same transportation job as normally done by a man with three horses would have taken 60 days. Piper dealer Ralph Brown, Ruidoso, N. M., contrived the basket rack in which steel posts in bundles of 20 weighing about 180 lb., were dropped with parachute attached from 11,000-12,000-ft. altitudes. Chute was a 10-ft. square of burlap.**

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# A new Britannia mark: non-stop....

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**The "Whispering Giant" flew 5,100 air miles non-stop London to the Pacific Coast in 14 hrs. 40 mins. at an average speed of 350 m.p.h with 6½ tons payload.**

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Passengers left London after breakfast and arrived in Vancouver for lunch . . . relaxed and refreshed after a completely restful and enjoyable ride.

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"Whispering Giant" uses standard runways and fits into existing air traffic patterns. She has been chosen by world operators for a wide variety of routes—from the longest trans-polar flights to short inter-city runs.

In a matter of months, Britannias will be flown between New York-Washington and New York-Miami by Northeast Airlines and between Mexico City-New York by Aeronaves de Mexico.

The same type of aircraft will also fly non-stop Atlantic routes for BOAC and El Al Israel Airlines, and trans-polar and trans-Pacific routes for Canadian Pacific.

**World-wide recognition and demand:**

Britannias are in service on BOAC routes spanning four continents and have been ordered by Aeronaves de Mexico, Canadian Pacific, Cubana de Aviacion, El Al Israel Airlines, Hunting-Clan Air Transport, Northeast Airlines, the Royal Air Force and the British Ministry of Supply.

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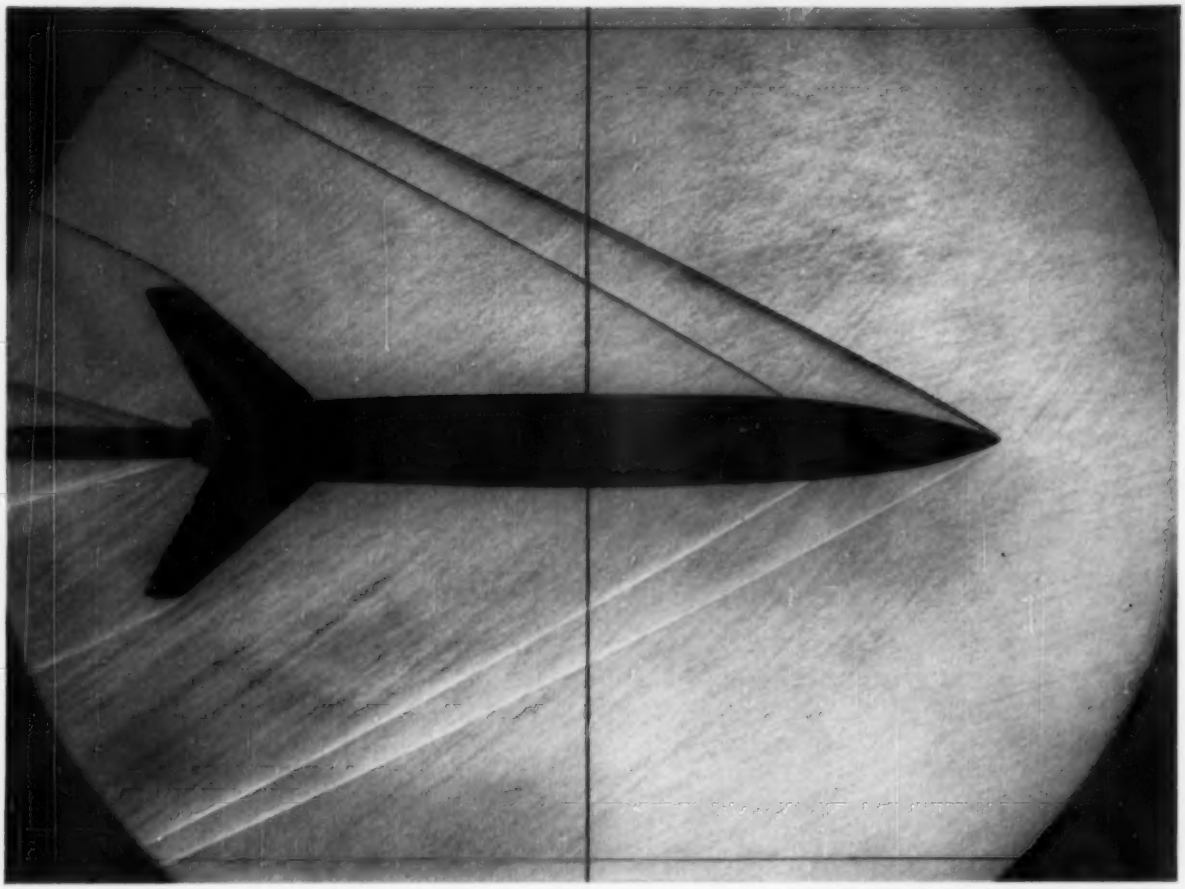

Schlieren photograph of supersonic flight patterns in wind tunnel.

## *There is a formula behind America's supersonic might*

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From the P-51 through the F-86 and the F-100, North American has designed planes with growth potential to use more power as it became available. It has translated this ideal performance into wing-strength reality—accurately, rapidly, and at lowest possible cost.

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NORTH AMERICAN HAS BUILT MORE SUPERSONIC AIRCRAFT THAN ALL OTHER COMPANIES COMBINED

elevator hinge. Elevator hinge cutouts were large and became sources of aerodynamic leaks. Fin and rudder were of similar construction except that a rubber sealing strip extended into the airflow at the fin and dorsal intersection. Ribbed structure of these surfaces also contributed to drag, the report finds.

### Modification Program

Major part of the Raspet modification program was aimed at reducing the number of protuberances, smoothing the surface and reducing controlling waviness. Balsa wood and Fiberglas bonded to the surfaces with epoxy resins were used. They added 260 lb. to the airplane's normal weight.

- **Landing lights** were removed from the wing. One was installed on the nosewheel gear to serve as a taxi/landing light, the other was submerged in the fuselage nose cone. Total head tube was also relocated to the nose.
- **Omni antenna** was buried in Fiberglas housing at the wingtips.
- **Ridged flaps,** ailerons, elevators and rudder were covered with fabric and doped; ridged surfaces of the stabilizers were smoothed with balsa wood and Fiberglas. Flap and aileron gaps were sealed with a brush material.
- **Fairings** were installed at the wing roots and on the engine nacelles.
- **Inspection doors** and access panels were refitted or replaced. Wings were smoothed.
- **Dorsal fin** was removed, and fuselage from the nose to just aft of the baggage door was smoothed.
- **VHF antenna** was relocated and made to serve as the aft mount for the ADF sensing antenna. Front mount for the ADF is an extension of the heater exhaust. A more compact unit replaced the previous marker beacon antenna.
- **Various vents** and drains on the fuselage were combined to produce minimum drag.
- **Engine** oil and vacuum pump vents that had been in high velocity region of the engine nacelle, were relocated and vented into the augmentor exhaust tubes.

### Emergency Use

Landing gear was not modified or sealed. Raspet feels that considerable power savings could be had with rework of this area if further research could be done to delineate the effect of cavity dimensions, wheel protuberances and cross effects. Beech Aircraft's primary intention in leaving portions of the wheels exposed was to provide effective shock absorbing points should an emergency wheels-up landing be made. Actual case histories of such landings have shown that this layout contributed greatly to minimizing undersurface damage.

Elimination of the dorsal fin did not affect single-engine speed, extrapolated data indicating that in this configuration, speed with left engine out remains at about 85 mph. There was no evidence of rudder lock, according to Raspet's report, the smoothing operations on vertical fin and rudder having eliminated this possibility.

Improved flow characteristics of the modified airplane resulted in better short-field characteristics, the report notes, there being sufficient elevator power at lower speeds to provide positive control. $C_{L_{max}}$ in level flight was increased 20%, providing reserve of lift for flare and landing.

These advantages were gained at the expense of stall warning, the report notes. Therefore Mississippi State College developed a Lift Reserve Indicator that basically measures the thickness of the turbulent boundary layer and provides a signal proportional to the lift coefficient. Signal is presented by audio and visual means to the pilot.

Detailed before-and-after photographic studies of the well-tufted specimen YL-23 made by Mississippi State College's Aerophysics Department show the flow improvements achieved.

While the performance gains engendered by these modifications would appear to be attractive to the civil owner, a major drawback aside from

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"I need a flubub pin," he said plainly, and hung up firmly.

The flubub pin arrived the next day. But it wouldn't fit. He sent it back, in a huff and called another Parts Supplier.

"I need a flubub pin, he said plainly, accenting every syllable and hissing his consonants. He hung up firmly.

Same results. No fit (unless you count the flyer's).

Then he called Airwork. But—before he could hang up, *somebody started asking questions.*

So—the next day he received the *right* flubub pin.

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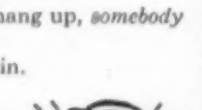

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cost would be Civil Aeronautics Administration approval. On a major change, such as removal of the dorsal fin on the Twin-Bonanza, CAA would probably require the owner to submit the airplane to exhaustive engineering and flight tests, both time-consuming and expensive.

The U. S. Army study contract with Mississippi State was not intended to produce immediate results, but rather to develop broad criteria on the benefits of geometric boundary layer control which light aircraft designers could apply to future projects.

An Army Transportation Corps official told AVIATION WEEK that the Corps may issue invitations to bid on proposals to modify its current fleet of airplanes to incorporate the modifications developed by Dr. Raspet. Fuel savings alone would pay for their cost in about 10 years operation of the planes.

## Business Flying Booms Philadelphia Airports

Activity at both city airports near Philadelphia is booming as a result of steady increases in business plane traffic. Traffic of "civil itinerant aircraft"—mostly business planes—went up 20% as of May 31 at International Airport compared with the same period last year; the increase of North Philadelphia Airport was 22%. Private planes made 12,013 landings and takeoffs at the former field during the Jan. 1-May 31 period, slightly under 14,523 movements at the latter field.

Philadelphia's Commerce Department is encouraging location of new industries on city-owned land near North Philadelphia, pointing out its convenience in relation to use of business aircraft. There are 71 business and pleasure planes permanently based at this field; some 65 planes, mostly used by companies are kept at International.

## Airwork to Expand Business Flier Forum

Millville, N. J.—Plans to enlarge greatly the scope of its annual Pratt & Whitney engine forum to cover broader fields of interests for business pilots are being developed by Airwork Corp. The engine overhaul and equipment supply firm will expand its previous one-day session to two days, introduce seminars on light flat engines, accessories and navigation equipment. Meeting will be held at Millville Sept. 19-20.

Also planned are static and flying displays of equipment for the corporate aircraft market, and a show of new business aircraft.

First day will have morning session on flat engines, and afternoon will be

*that's the word, sir...*

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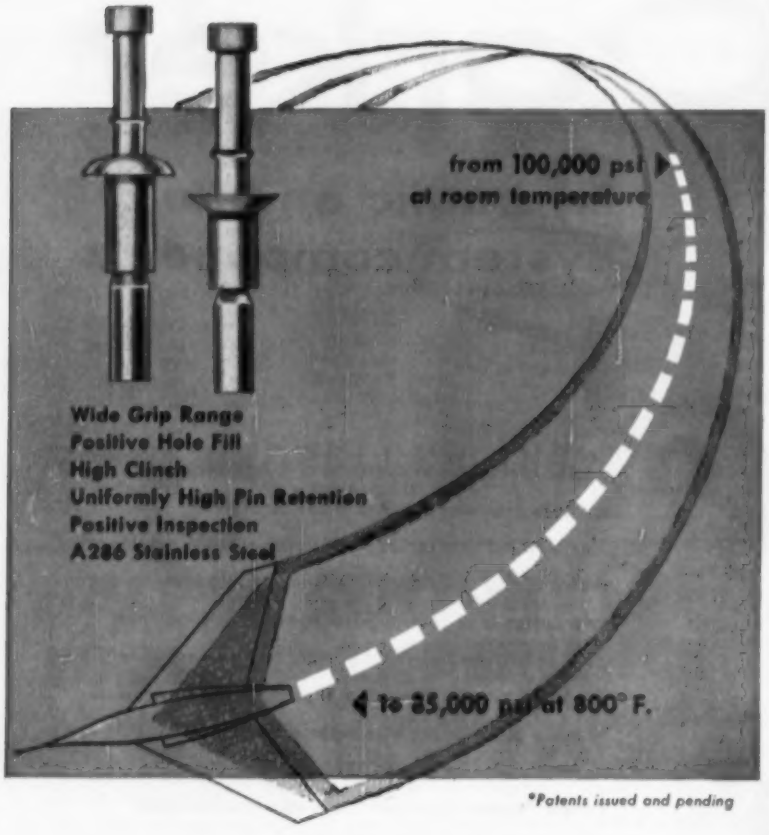
# for Hi-Strength at Hi-Temperature the Cherry "600" Rivet*




*Patents issued and pending

To meet the design requirements imposed by extremely high-speed aircraft and missiles, the Cherry Rivet research and development department has introduced the "600" A286 stainless steel blind rivet.

Data on the strength capabilities of the "600" rivet is available from Townsend Company, Cherry Rivet Division, P.O. Box 2157-N, Santa Ana, California.

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devoted to accessories. Latter will be organized so that each accessory manufacturer will hold individual "round-table" discussions with interested users —"circles of information," as Airwork calls these. Morning session of second day will cover communications and navigation, afternoon will be devoted to P&W engines.

## PRIVATE LINES

**Cessna do Brasil,** new affiliate of Cessna Aircraft Co., Wichita, Kans., obtained permission from the South American government to import equipment at a special exchange rate for a new plant in Sao Paulo which will produce 170 and 180 business planes.

**Piper Aircraft sales** for first nine months of fiscal year ending Sept. 30 were $21,523,508, with net income after taxes being $2,420,026. Sales were up 13% and net income 33% compared to same period last year. In the nine months period Piper built 1,900 aircraft, principally business and utility aircraft.

**Formation** of a Venezuelan commercial aerial survey firm has been completed by Photographic Survey Corp., Ltd., Toronto, which merged its former Caracas operation, Aeromapas Nacionales with Seravenca, an established air photo laboratory and photogrammetric organization.

**Business calls were doubled** by a salesman in the Los Angeles area using a Beech Bonanza and folding motor scooter to cover sprawling area. Rex Corder, owner of Advance Carpet Service which lays carpeting for 70 retail stores in the area, seldom flies the Bonanza beyond metropolitan Los Angeles. He beats traffic congestion by landing at the nearest field, using the scooter to visit clients.

**Third consecutive annual contract** for overhauling Fourth U. S. Army's Bell and Sikorsky helicopters was awarded Howard Aero Service, San Antonio, Tex. New contract covers period July 1, 1957-June 30, 1958.

**Priced at under $100,** radio transceiver can use aircraft's cigarette lighter as power source. Vocaline unit operates on a fixed frequency, requires no tuning; operator pushes a button to talk. Unit is being distributed by Air Associates Division, Electronics Communications, Inc., Teterboro, N. J.

**Five Beech E50 Twin-Bonanzas,** valued at more than $500,000, have been ordered by Swiss and Moroccan Air Forces for liaison work.

## MISSILE SYSTEMS FLIGHT DYNAMICS

Weapon systems management activities at Lockheed's Palo Alto, Sunnyvale and Van Nuys organizations demand accomplishment of a high order in flight dynamics areas such as: Analysis of missile dynamic motion and establishment of stability and control system criteria for trajectories with 3 or more degrees of freedom; development of techniques for the analysis and interpretation of flight dynamics test data at hypersonic speeds; study of special dynamics problems arising during preliminary design and development of missile systems. Inquiries are invited. Please address the Research and Development Staff, Sunnyvale 31, or Van Nuys 19, California.

*Left to right: S. S. Edwards, flight dynamics; B. W. Marsh, aerodynamics; M. Tucker, Aerothermodynamics Department manager; and R. L. Nelson, project aerodynamics, discuss reentry dynamics.*

*Lockheed*

MISSILE SYSTEMS DIVISION

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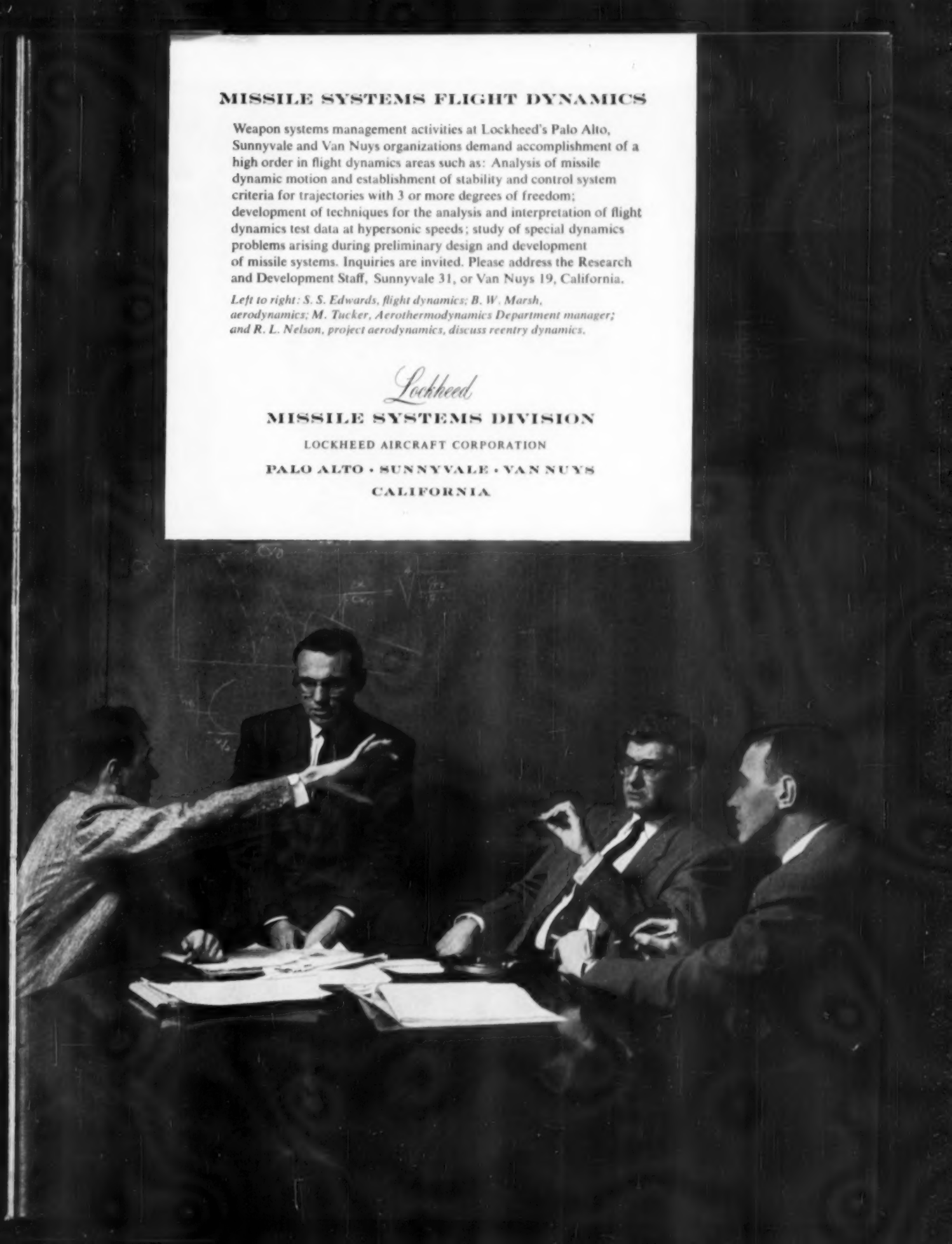

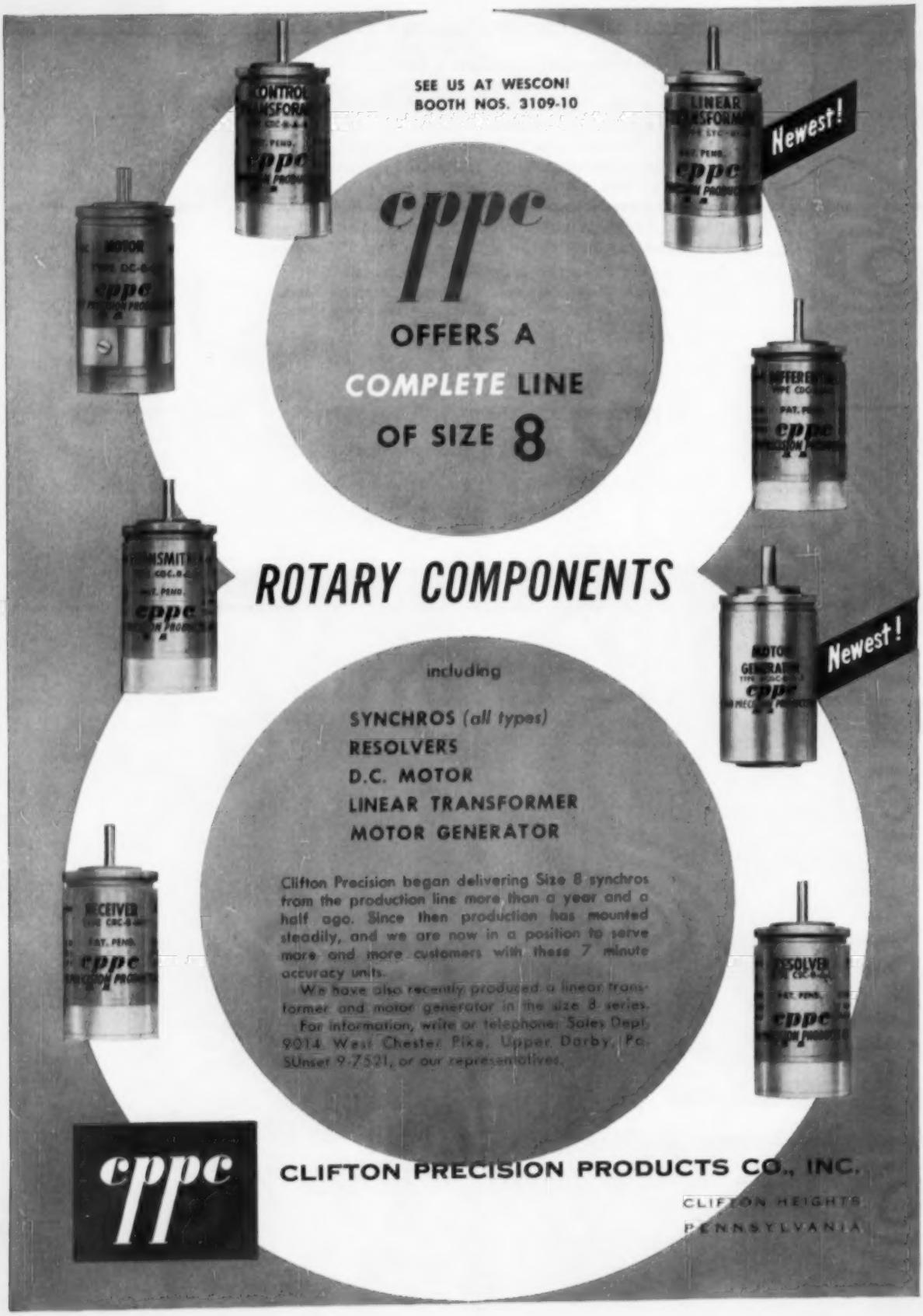
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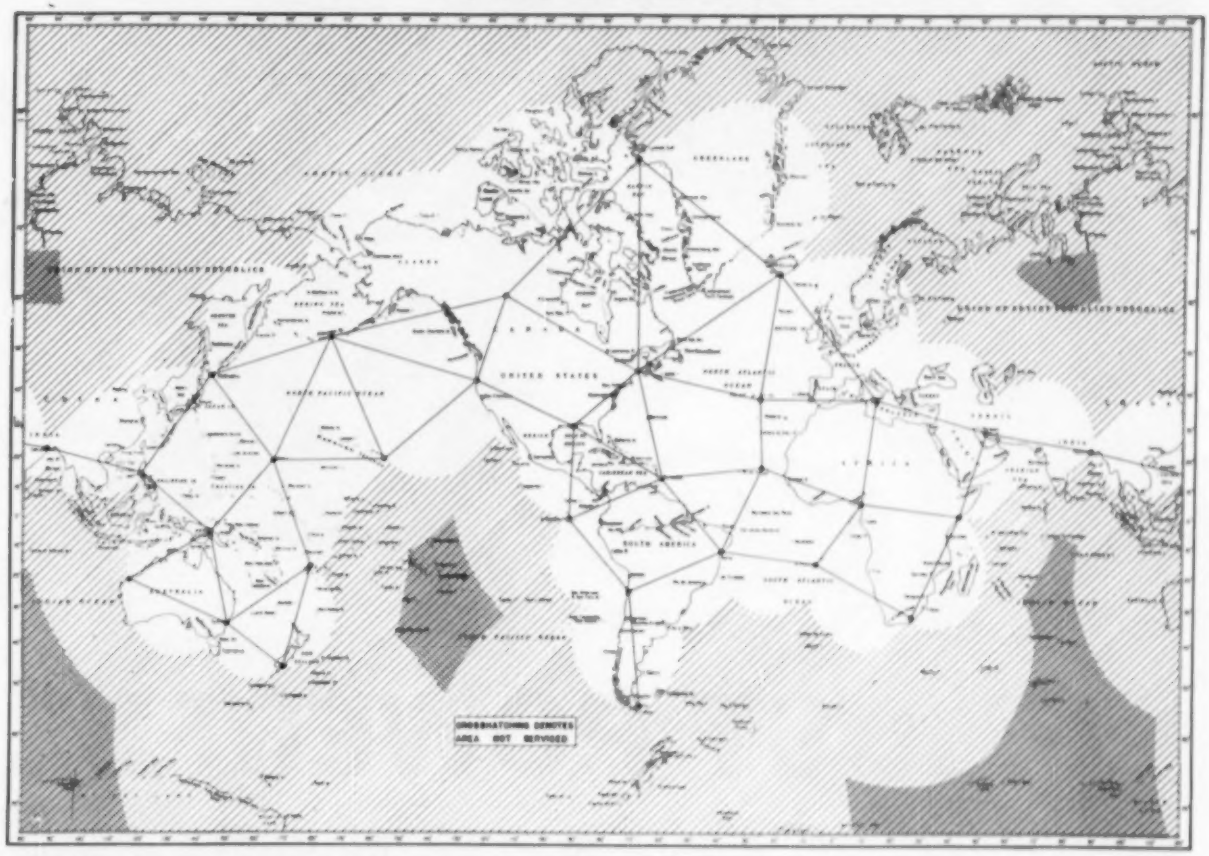



**COVERAGE** of a possible distribution of 30 Navarho stations. Service area of standard Navarho is outlined by heavy crosshatching and that of Navarho-H and Navarho-rho by light crosshatching.

# 3-Mile Accuracy Claimed for Navarho-rho

By James A. Fusca

**Rome, N. Y.**—Worldwide navigation accurate to within three nautical miles, a degree of accuracy hitherto unclaimed for any long-range system, may be possible with a modified version of Navarho long range navigation aid, according to a Rome Air Development Center spokesman.

Disclosure was made here at a symposium for presentation of results of a joint Rome and Wright Air Development Center evaluation of the Navarho system. Symposium was attended by representatives of the military services and civil aviation agencies.

Navarho is the long range navigation system officially selected by the Air Coordinating Committee as U. S. contender for adoption by the International Civil Aviation Organization, which places it in competition with such systems as Dectra and Delrac and certain classified military systems.

The new version of Navarho, called Navarho-rho, is one of three modified Navarho systems discussed. Two others, called Navarho-H and Navarho-HH, were suggested recently by Federal Telecommunication Laboratories which developed Navarho under a Rome Air Development Center contract.

### Three New Versions

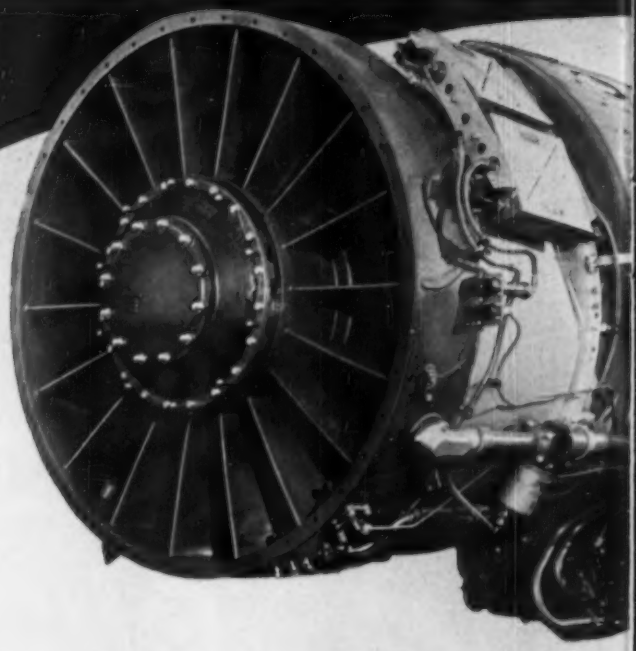
All three modified versions of Navarho operate from the same ground station transmissions as the basic Navarho system (AW April 26, 1954, p. 52) so that the mode of operation used by an aircraft or surface vessel will be determined by the receiver installation. Differences in system characteristics are as follows:

• **Navarho.** The standard rho-theta (range and bearing) Navarho system derives range by phase comparison of the received ground station signal with an internal precision frequency standard or "clock." Bearing is measured by amplitude comparison of pulse signals received from the ground station as the transmitted signal is switched in sequence among three directional antenna combinations.

• **Navarho-H.** Also a rho-theta system, bearing is obtained in the same manner as with Navarho but range is measured through derivation from two ground station signals of a hyperbolic line of position (LOP) which intersects the bearing line.

• **Navarho-HH.** A fully hyperbolic system, Navarho-HH requires the reception of three ground station signals to generate two intersecting hyperbolic lines of position.

• **Navarho-rho.** A circular position fixing system, Navarho-rho measures distance in the same manner as Navarho but from two ground stations to determine position by the intersection of the two range circles. A third ground station may be used to resolve the ambiguity of the range circles intersecting



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Producing about 50 per cent more thrust than the famed J-57, its forerunner, the J-75 is in the 15,000-pound thrust class. Its power can be greatly augmented by use of an afterburner.

The J-75's basic configuration stems from the J-57's axial-flow design, which features simple, permanently fixed stator vane construction. Despite its 50 per cent increase in thrust, the J-75 is only slightly larger than the J-57, with a lower specific weight and outstandingly low specific fuel consumption.

Already announced as the power plant for the Republic F-105 fighter for the Air Force and for production models of the Navy's Martin P6M seaplane, the J-75 will also power other Air Force and Navy high performance aircraft still on the classified list. Its commercial version, the JT4, will power a majority of the Boeing 707 and Douglas DC-8 jet airliners ordered by the world's leading airlines, while others will be powered by the JT3, commercial version of the J-57.

Quantity production of the J-75 again demonstrates that—whatever form the future takes—Pratt & Whitney Aircraft is prepared to offer continued advancement in power plant design and production.

# Pratt & Whitney Aircraft

*Division of United Aircraft Corporation, East Hartford, Connecticut*

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# TECHNIQUES and DEVELOPMENTS
## in oscillographic recording

FROM
# SANBORN

### DESIGN PRINCIPLES AND SOME APPLICATIONS OF A PREAMPLIFIER FOR LOGARITHMIC MEASUREMENTS

THE Model 150-1400 Log Audio Preamplifier (Figure 1), one of eleven plug-in "front ends" now available for 150 Series systems, permits measurements involving logarithmic or exponential functions. The "Log Diode" circuit (shaded portion of circuit block diagram in Fig. 2) is the heart of this instrument, and is based on the logarithmic relationship between the voltage across a thermionic diode and the current through it. If $R$ is large, the current through the diode $i_1$ becomes proportional to the voltage $e_1$, and the logarithmic relationship of $e_2$ and $i_1$ is transformed into a logarithmic relationship between $e_2$ and $e_1$. Circuit constants for this Preamp were chosen to provide an accurately logarithmic relationship between $e_2$ and $e_1$, over the range of 200 to .63 volts for $e_1$. This is a 50 db spread, and the gain of the DC output amplifier (fed by $e_2$) is arranged so that a 50 db variation in $e_1$ produces a 50 mm stylus deflection.

Fig. 1

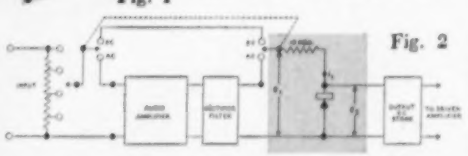


Fig. 2

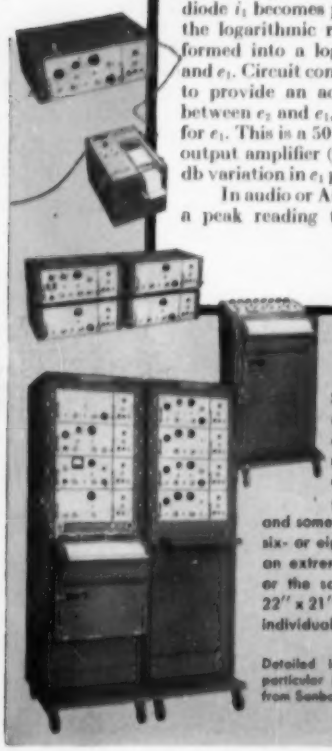
In audio or AC measurements, $e_1$ is derived from a peak reading type rectifier-filter circuit, which follows a high quality 20 cycle — 20 KC audio amplifier. With an input of 100 mv RMS, this amplifier will produce a 200 volt output from the rectifier. The 50 db chart, therefore, corresponds to a variation in AC input voltage of 0.316 to 100 mv.

In DC measurements, the audio amplifier is bypassed and the input applied to the diode circuit. Since the diode itself is a rectifier, used in the forward direction with its cathode near ground, the DC input must be polarized with the high side positive.

One broad area of application for the Log Audio preamplifier is audio level recording. For example, room reverberation time can be measured by recording sound level decay after the sound source is suddenly turned off, the reverberation time considered the period required for a 60 db decay to occur. Another example of audio signal recording is the plotting of frequency response curves of audio equipment such as microphones, filters, loudspeakers, etc. A multi-channel recording system with appropriate filters also makes possible audio spectrum analysis.

A second major type of application of this Preamp is the recording of DC voltages on a db basis. If the signals are small, a chopper can be used to convert DC to AC, thus taking advantage of the Preamplifier's audio amplifier. With an impedance matching transformer added to such an arrangement, the system becomes a logarithmic DC millivoltmeter or logarithmic DC microammeter of extreme sensitivity. Such a device could be used for plotting the volt-ampere characteristic of a germanium diode, which might be very helpful in selecting matched pairs of diodes. Another possibility is plotting the output of a fixed gain radio receiver and linear detector to a db scale, to rapidly record antenna performance data.

A comprehensive discussion of the design and these applications of the Log Audio Preamplifier is contained in an article by Dr. Arthur Miller, Chief Electrical Engineer of Sanborn Company, published in the Sanborn RIGHT ANGLE. Copies are available on request.



### Which Oscillographic Recording "PACKAGE" fits your needs?

SANBORN "150's" are housed, basically, in either of two ways: a vertical mobile cabinet, or separate portable cases for amplifier and recorder units. This in itself provides a number of "packaging" possibilities, but the number is greatly increased by various other alternate, and sometimes special, housings. For example, an entire six- or eight-channel recording assembly is available in an extremely compact, mobile cabinet only 45" high; or the same recorder can be portably housed in a 22" x 21" x 23" case. If field use of "150's" is planned, individual units in cases fitted with removable covers and carrying handles, connected by patch cords, may be the best answer. Occasionally only a "special" adaption will meet a specific need.

But whatever the "150" oscillographic recording "package" you use, you're assured of basic Sanborn "150" advantages: *inkless recordings in true rectangular coordinates; 1% linearity, resulting from high torque galvanometers and current-feedback driver amplifiers; numerous chart speeds, from 0.25 to 100 mm/sec.; choice of single to 8-channel systems, readily adapted to new requirements by plug-in Preamplifiers selected from 11 presently available types.*

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# Navigation Geometry

A semantic problem exists in any discussion of long range navigational aids in that the majority of the systems proposed to date are capable of providing position fix information by several different methods. This problem is typified by the four forms of Navarho proposed thus far. (Other airborne equipment configurations are possible and doubtless will be considered in the future.) The problem arises because as the accuracy of the geometrical position fix solution increases the complexity, cost and weight of the airborne equipment increases proportionately. The three basic geometrical solutions are:

• Theta-theta. A two-bearing position fix is the simplest but least accurate method of determining position. As the distance from the ground station increases or as the angle of intersection of the bearing lines decrease from 90 deg., accuracy is reduced.

• Rho-theta. Accuracy of range and bearing measurements from a ground based aid has been considered adequate for short range systems but with a rho-theta system, as with a theta-theta system accuracy of fix decreases as the range from the ground station increases and the equivalent beam is broadened.

• Rho-rho. Range determining systems offer the best theoretical accuracy but accuracy varies with the method of solution used by the airborne computer. If the range from two ground stations is found independently, the geometry of the solution is circular: that is, position is fixed at the intersection of two circles of constant range. If range difference is used by the computer, the lines of position derived are hyperbolic. If range sum is used, the geometry of the solution is eliptical.

Because the theoretical maximum accuracy of a position fix is obtained when the lines of position intersect at right angles, a combination solution using both hyperbolic and eliptical lines of position represent the optimum system because the two families of curves always intersect at right angles.

twice, at equal distances from the baseline if necessary.

As this list indicates, the approaches proposed for Navarho resemble the standard Navarho system only in that the same ground station transmissions are used.

It is a tendency of present day low and very low frequency navigation systems to borrow successful techniques from competing systems as propagation data and test results direct system designers in similar directions.

Each of the three modified versions of Navarho offer advantages for different types of position fixing service, according to their proponents.

Rome Center engineers, primarily concerned with the military requirement for extremely precise navigation over long ranges, have advanced Navarho-rho despite the relatively higher cost and weight of the system with its crystal or atomic stable frequency reference requirements.

It was this military requirement for accurate navigation at long ranges that was the basis of recent Air Coordinating Committee action in adopting the stringent requirement of three nautical miles accuracy with 95% reliability as a criterion for navigation aids (ACC Document 58-9.1).

Federal Telecommunication Laboratories' engineers, on the other hand, emphasize that civil air traffic control requirements, especially at longer ranges, are not this severe. Their predicted accuracy of 15 nautical miles at extreme range for Navarho-H, they believe, will be attractive to civil operators because of estimated savings of about 50% in cost, size and weight of the airborne equipment as compared with standard Navarho.

A second advantage claimed for Navarho-H is that, being a rho-theta system, its outputs may be fed directly to the computer of a self-contained navigation device such as a Doppler navigator.

The Laboratories also point out that a fully hyperbolic system such as Navarho-HH is capable of the high accuracy of a fully hyperbolic system with simple and economical receiving equipment when used with navigation

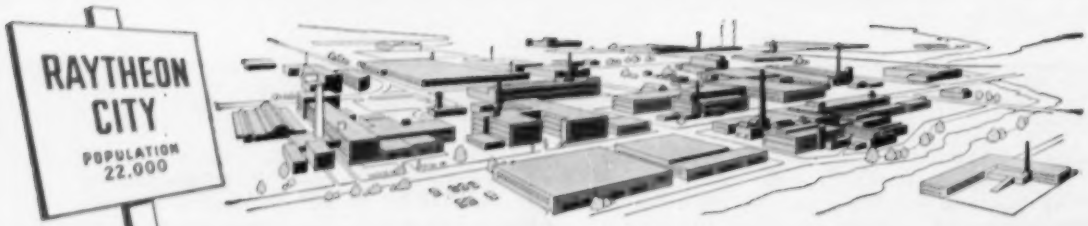
| | Coverage | Accuracy | Size and Weight of Airborne Equip. | Clock (Stable Frequency Reference) | No. of Stations per Fix | Type of Fix |
|---|---|---|---|---|---|---|
| Navaglobe (Bearing only) | 1,500 miles around each station | 0.5° * | 25 lbs. 0.5 ft.$^3$ | No | 2 | θ/θ |
| Navarho (Bearing & Distance | 1,500 miles around each station | ** 15 n. m. *** | 90 lbs. 2 ft.$^3$ | Yes | 1 | ρ/θ |
| Navarho H | See map | 15 n. m. *** | 60 lbs. 1 ft.$^3$ | No | 2 | ρ/θ |
| Navarho HH | See map | 3 to 5 n. m. | 50 lbs 1 ft.$^3$ | No | 3 | Hyperbolic |
| Navarho - rho | See Map | Better than 3 n. m. | 70 lbs. 1.5 ft.$^3$ | Yes | 2 | ρ/ρ |

* One LOP (Line of Position) only.

** Exclusive of clock error which increases with time.

*** At extreme limits of service area. Accuracy is improved at shorter ranges.

COMPARATIVE CHARACTERISTICS OF NAVARHO SYSTEMS



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Ultra-modern Wayland Engineering Laboratory is an important new landmark in the development of Raytheon "City"—a rapidly growing community of electronic centers extending from Massachusetts to California. Here are the vital statistics:

**POPULATION:** 2,000 scientists and engineers; 22,000 skilled men and women in all.

**BUILDINGS:** 21 plants and laboratories.

**WORK AREA:** 861,000 square feet of engineering space; a total of 4,062,827.

**ACTIVITIES VITAL TO NATIONAL DEFENSE:** Missiles—Navy Sparrow III and Army Hawk; Radar for the Air Force's B-58 and B-52; DEW line radar; tubes, transistors, counter-measures.

**REPUTATION:** World-wide.

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# How Holley's Compressor Governors Help New Jets to Supersonic Speeds

"City-savers" Air Force men call them: the J-57-powered F-100, F-101, F-102 and Navy F8U, with level flight speeds faster than sound. And city-savers they could well be. Certainly their rapid approach to the fringe of Mach 2 heralds a new era in the progress of jet flight.

Sharing in the development of this new brood of supersonic fighters, Holley engineers, working closely with Pratt & Whitney Aircraft on the J-57 engine, designed the compressor bleed governor.

This new Holley compressor bleed governor is one more example of Holley's continuing leadership in the design, development and manufacture of superior engine control systems for both military and civilian use

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A-24

charts printed with hyperbolic coordinates and first order corrections for differential propagation delays. Such a system would be of use in air and marine navigation where the time required to plot position manually on a chart is acceptable.

### Navarho's Status

The future of Navarho in any or all of its four versions will be determined during preparation of the U. S. position to be presented at the International Civil Aviation Organization meeting at Montreal in September. USAF's Air Staff presently is studying the results of the evaluation and the proposed future program for the purpose of establishing the Air Force position.

The Air Force position will be coordinated with the other military services by the Joint Chiefs of Staff to determine the Armed Forces position for submission to the Air Coordinating Committee which has responsibility of establishing the U. S. position for international presentation.

According to Navarho's developers, 30 ground stations are capable of providing nearly worldwide coverage. A possible distribution of stations is shown on the map. Spacing between the stations is about 2,000 mi., the approximate maximum service range. On the map, heavy crosshatching outlines the service area for standard Navarho and light crosshatching the service area for Navarho-H and Navarho-rho.

Stations must be sited within service range of one another to maintain the synchronization required for distance measurement. This is because the frequency standards of the Navarho and Navarho-rho receivers must be in phase with every ground station carrier with which they are expected to work. Additionally, Navarho-H, which derives distance from phase comparison of two ground station transmissions, requires synchronization of all ground station carriers.

### Navarho Fundamentals

Standard Navarho is a low frequency navigation system that provides position fix information in the form of bearing and radial distance from one ground station. With the required channel spacing of 1 kc., 20 channels are available anywhere in the world in the internationally allocated frequency band of 90-110 kc.

Bearing from a ground station is derived from the transmitted pulsed carrier. At the ground station three antenna towers are located at the corners of an equilateral triangle, approximately one third of a wavelength (about 4,000 yd.) on a side.

The bearing carrier is pulsed on for one sixth of a second four times each second and applied sequentially to pairs

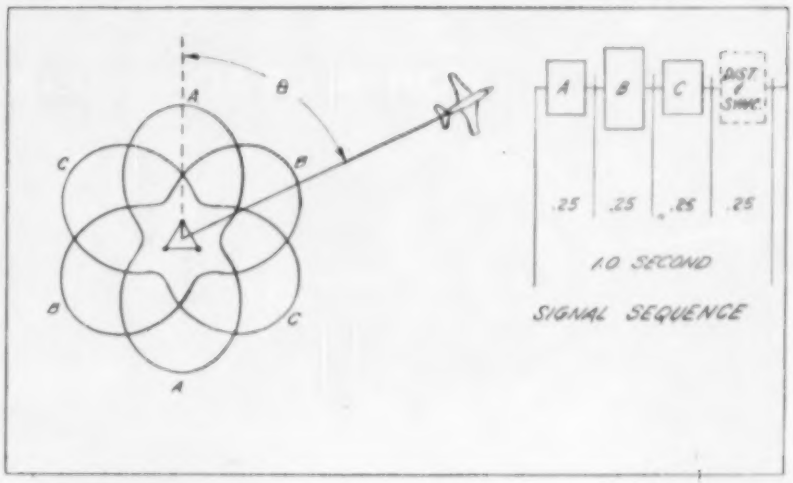



**FIGURE-EIGHT** directional patterns of Navarho ground station transmission and sequence of the transmitted pulse signals.

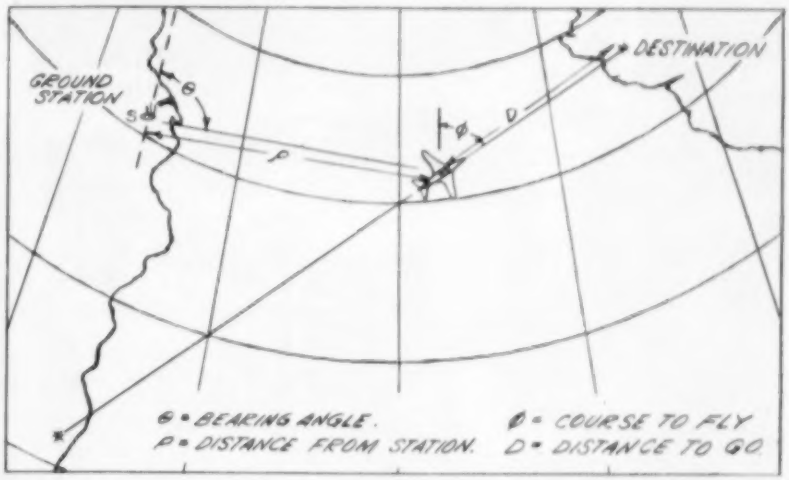
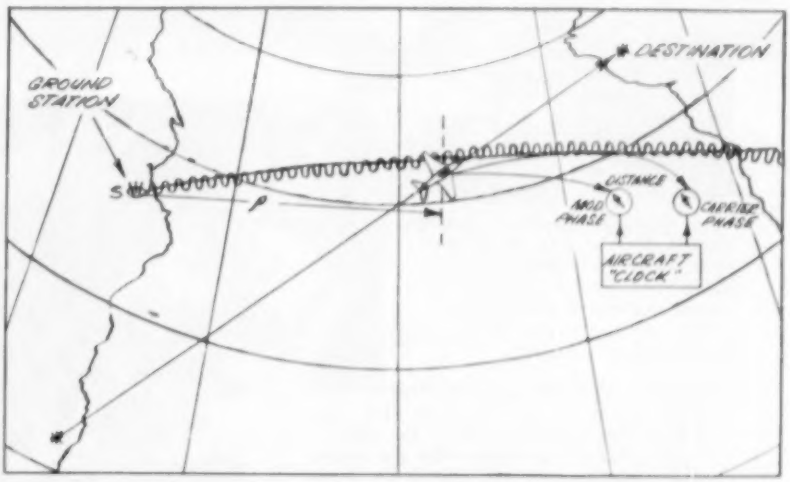
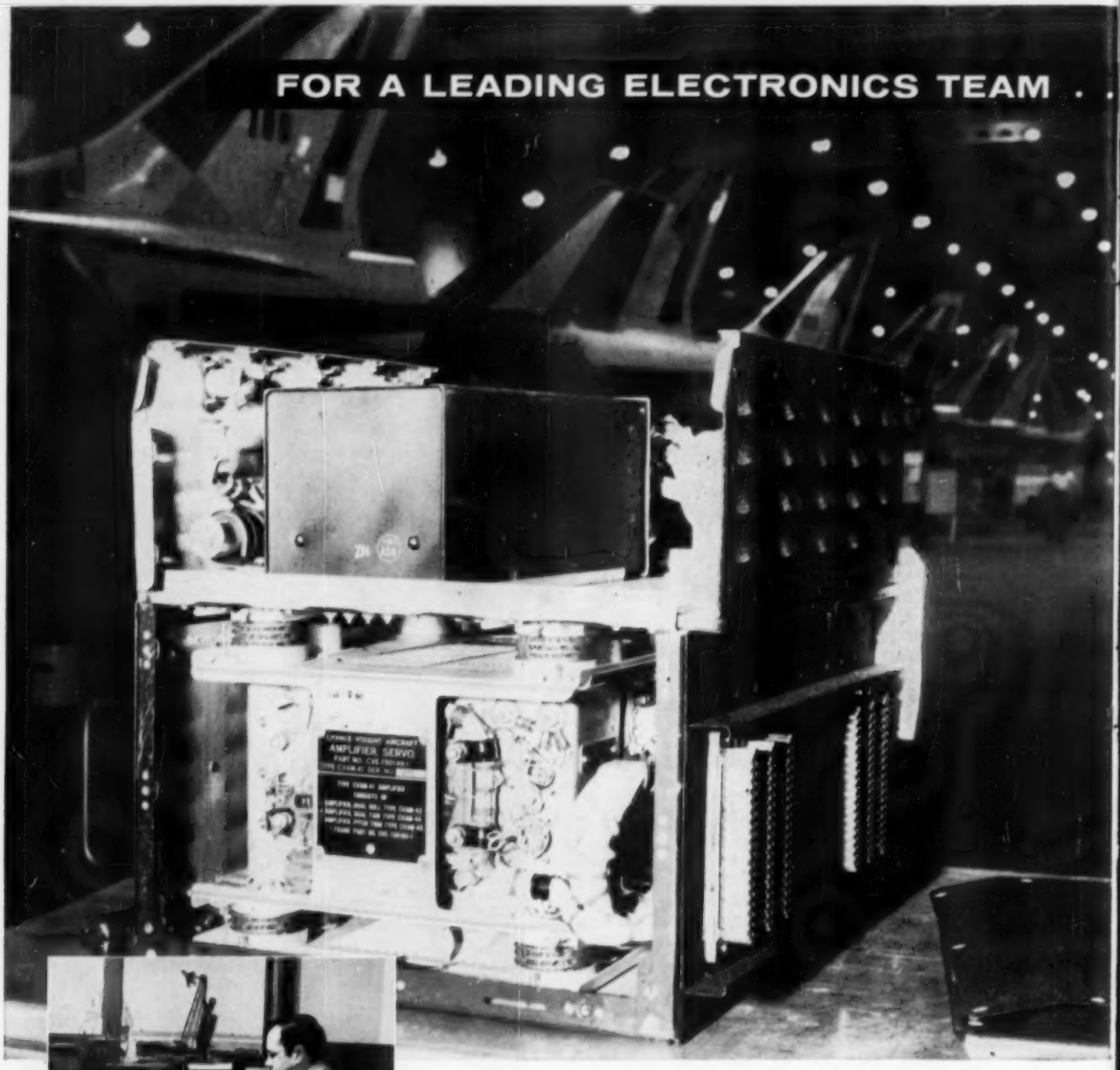



**DIAGRAM** of the coordinate system for bearing and distance measurement used with the standard rho-theta Navarho system.

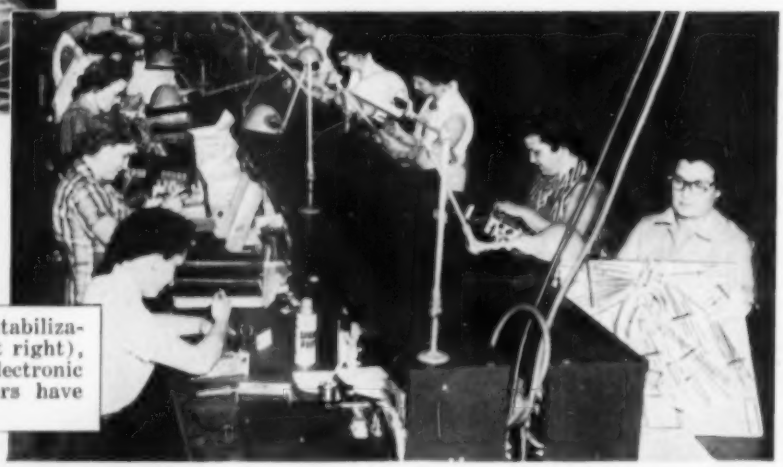



**COARSE** and fine distance measurement in the standard Navarho system is made by phase comparison of tone modulation and carrier frequencies.

# FOR A LEADING ELECTRONICS TEAM . .



R & D in electronics is conducted at Vought in modern facilities like this antenna range, one of many Vought labs where engineers are improving electronics' weight, cost and performance factors.



On production lines like this stabilization system assembly setup (at right), Chance Vought produces the electronic control equipment its engineers have developed.

**. . A LEADING QUESTION**

# *Why do Vought electronic projects bring out the best in an engineer?*

. . . Because they stand for the things an engineer values most.

There's theory and research adventure to begin with. There's the opportunity to systematize and package the most advanced components. And there's the good feel of production-line hardware at the end of a successful project.

Right now, the Vought engineer is experiencing these attractions in a number of different electronics efforts. And whether it's fire control systems, antenna design, or power control development, it's a project that has his respect. For he knows — probably from experience — that he's been given an *undiluted* challenge . . . that he is doing things that haven't been done before.

You understand the Vought engineer's enthusiasm when you examine his projects. Take the stabilization system for Vought's Crusader fighter:

Here, to begin with, was an epic problem:

The aircraft was designed to travel in the transonic realm where control stability is marginal or negative.

The engineer's job: to keep Crusader control in the cockpit by means of an electro-mechanical system the pilot can command with his fingertips.

Solving this problem, Vought engineers explored the dynamics of servomechanisms. They called on the latest in circuit designs, and they brought together revolutionary new components. Finally, they came up with a package — tailored for a small space in the aircraft, and for low-cost, trouble-free production, too.

. . . A man-sized program, in an area few engineers have the opportunity to explore. Typical of the electronics projects engineers can count on at Vought.

## 4 IMMEDIATE OPENINGS FOR ENGINEERS

**Designer.** Special support equipment designer for checkout of stabilization and other electronic systems. E. E. degree, or equivalent required, plus 3 to 5 years electrical or electronic design experience.

**Reliability Engineer.** To review and evaluate aircraft and missile components and to perform environmental tests. Requires E. E. degree, or equivalent, and knowledge of statistical quality control.

**Systems Engineer for Design and Test of Communications, Radar, Fire Control, Infrared, and Navigation Systems.** Requires engineering degree or equivalent, plus 2 to 4 years related experience.

**Systems Engineer.** To design and test hydro-mechanical and electro-hydraulic servo control systems. Requires engineering degree, or equivalent, plus 2 to 4 years related experience.

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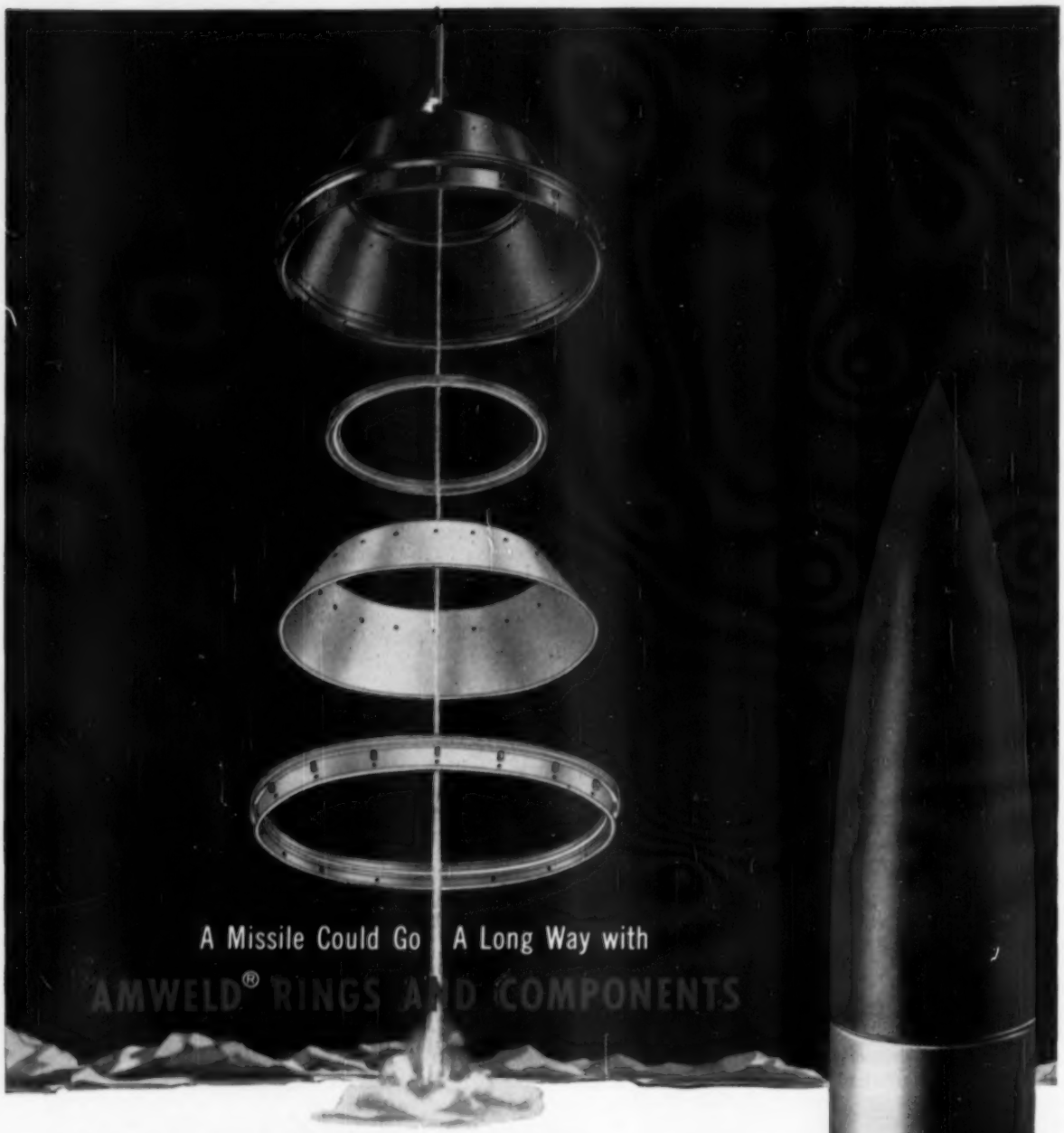


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of towers during each pulse, producing three figure eight patterns for three antenna pairs.

A fourth pulse is applied to a single tower to radiate an omnidirectional signal. An offset synchronization carrier pulse is also radiated from this tower in time coincidence with the fourth bearing carrier pulse. As shown in the sketch, the first three sequential carrier pulses form a bearing triad referred to as A, B, and C. The fourth pulse provides a synchronization signal and is used in distance measurement.

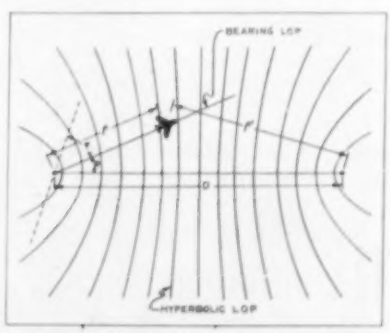
The magnitude of the radiated signal varies sinusoidally at constant radius about the figure eight patterns for each antenna pair. Since each antenna pair axis is 120 deg. away from the preceding pair, three sinusoids with 120 deg. separation are observed at constant radius from the antenna site. These pattern characteristics determine the amplitudes of the received bearing pulses.

The receiver compares the relative amplitudes of the pulses to derive bearing to the station. An ambiguity of 180 deg. exists in the bearing measurement but is not considered to offer an operational problem.

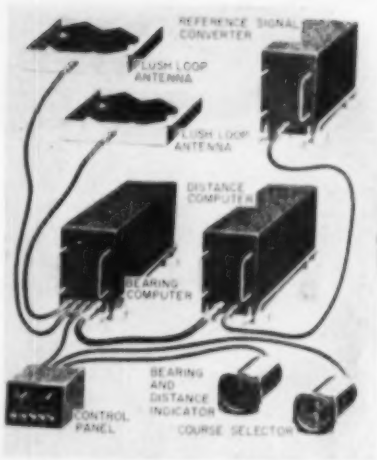
### Distance Measurement

Distance is measured at the receiver by two different methods, both based on the principle of phase comparison. The first method compares the phase of an audio signal impressed on the fourth or synchronization pulse with a reference signal derived within the receiver by the dividing down of the precision frequency reference signal. The second method is based upon phase comparison of the received carrier with the receiver's reference signal.

The first method provides discrete distance measurement over an interval determined by the modulation frequency. If this frequency is 250 cps., distance readings will be repeated every 647 nautical miles. To use this method of distance measurement, the phase of the receiver audio signal is aligned at




**FAMILY** of hyperbolic lines of position are used for distance measurement by Navarho-H system.




**NAVARHO-H** airborne receiver installation.

the start of each trip with that of the audio signal at the ground station. Thereafter, the amount of phase shift accumulating is displayed by the receiver as a coarse measure of distance traveled.

Distance measurements based on carrier frequency are repeated every 1.6 nautical miles and are, therefore, highly ambiguous unless set and counted from the start of each trip or unless the two methods of measurement are used together to provide both coarse and fine distance information.

An airborne Navarho installation for the measurement of bearing only weighs 25 lb. and occupies 0.5 cu. ft. With the addition of a distance measuring unit and a crystal frequency standard, the weight of the installation is increased to 90 lb. and the size to 2.0 cu. ft.

### Navarho-H System

If the fourth pulse (distance and synchronization pulse) of the transmitted signal from one ground station is used as the frequency and phase reference for the signal received from a second ground station, there is no need for a stable frequency reference at the airborne receiver. This method, called Navarho-H, measures the differential distance from the two stations and thereby locates the aircraft on a hyperbolic line of position between the two stations.

As with distance measuring in standard Navarho, measurements can be made on the common modulation tone from the two ground stations or by differential phase measurement between the two carriers. These two measurements together result in a coarse and fine hyperbolic network. Based on a modulation frequency of 250 cps., the hyperbolic lines of position will reoccur every 324 mi. along the baseline. Thus, the pilot must know his position within 324 mi. or the system must include provision for counting cycles of phase to resolve the system ambiguity. Precise distance lines of position are then established by carrier phase measurements.

The receiving equipment to accomplish bearing and differential distance measurement consists of the standard Navarho bearing unit and, as a replacement for the stable frequency reference, a one-half ATR cabinet which contains additional receiving equipment, a slaved oscillator and a coordinate converter. Total installation weight will be approximately 60 lb. and it will occupy 1.0 cu. ft.

### Navarho-HH System

In any area where more than two ground stations can be received, intersecting hyperbolic lattices will create position fixes without the use of bearing measurement equipment. When the Navarho ground station transmissions are used in this manner it may be possible to obtain three to five mile accuracy throughout the service area. With first order corrections for differential propagation delays, even higher accuracies may be obtained.

The airborne installation required for Navarho-HH service consists of two one-half ATR boxes weighing approximately 50 lb. and occupying approximately 1.0 cu ft.

The data display will be in the form of microsecond delay readings.

This installation does not include a computer to convert the hyperbolic fix coordinates to latitude and longitude. Such computers are, however, in development.

In marine and air service where a navigator has sufficient time to plot a chart position manually, a computer may not be necessary.

Engineers of Rome Air Development

## Missile Radome

**Ceramic radome for missile, capable of operating at extremely high temperatures, has been developed by Gladding, McBean & Co., Los Angeles, under Air Force sponsorship. Ceramic radomes reportedly have a hardness approaching that of diamonds.**

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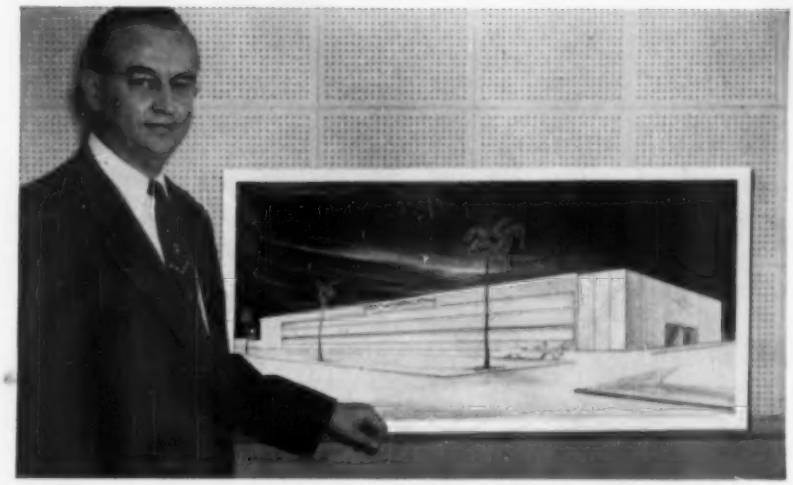
## REPORT FROM RYAN

# New Engineering Opportunities Created as Ryan Projects Mushroom



**FRANK W. FINK, RYAN VICE PRESIDENT AND CHIEF ENGINEER** inspects architect's drawing of new Engineering and Research Center.

## New Engineering and Research Center To Meet Ryan's Expansion

Construction of a modern two-story, engineering and laboratories building has begun at Ryan, to meet the company's expanding work in Jet VTOL—Automatic Navigation—Jet Drones—Missile Guidance—Jet Metallurgy—Rockets.

The new facility will provide additional quarters for many of the 1000 employees in Ryan's fast-growing engineering division. It will also house complex, new chemical, metallurgical, instrumentation, environmental and autopilot equipment.

With one in six Ryan employees in engineering, this division has tripled in three years. Its mushrooming growth reflects Ryan's increased importance as a research facility in aerodynamics, propulsion and electronics.

**RYAN ENGINEER** "zooms" straight up in unique rotatable cockpit.

## Vertical Flight Probed with New VTOL Cockpit

Shortest way into the sky is straight up—in the Ryan Vertijet. To probe this new realm of flight without becoming airborne is a trick performed daily by Ryan engineers. Their secret? A rotatable cockpit connected with electronic computers.

Ryan's flight simulation laboratory is a prime tool in the test of new aircraft designs. Both the Vertijet and the subsonic, turboprop-driven Vertiplane are put through their paces via earthbound flight test. Ryan leadership in this revolutionary new concept of flight is based upon 2¼ million manhours of VTOL research and development. It is another example of how Ryan builds better.

## Ryan Automatic Navigator Guides Global Flight

An advanced system of aerial navigation, designed for high speed, long range flight, has been developed by Ryan electronics engineers, working under sponsorship of the Navy's Bureau of Aeronautics.

Designated AN/APN-67, the new navigator is the lightest, most compact, self-contained electronic navigator in production. Developed to meet military needs, it will also meet commercial jet flight requirements.

The system provides pilots and navigators with continuous information on longitude, ground speed, ground mileage, drift angle and ground track. It is accurate and instantaneous. Requires no computations, ground facilities or wind data.

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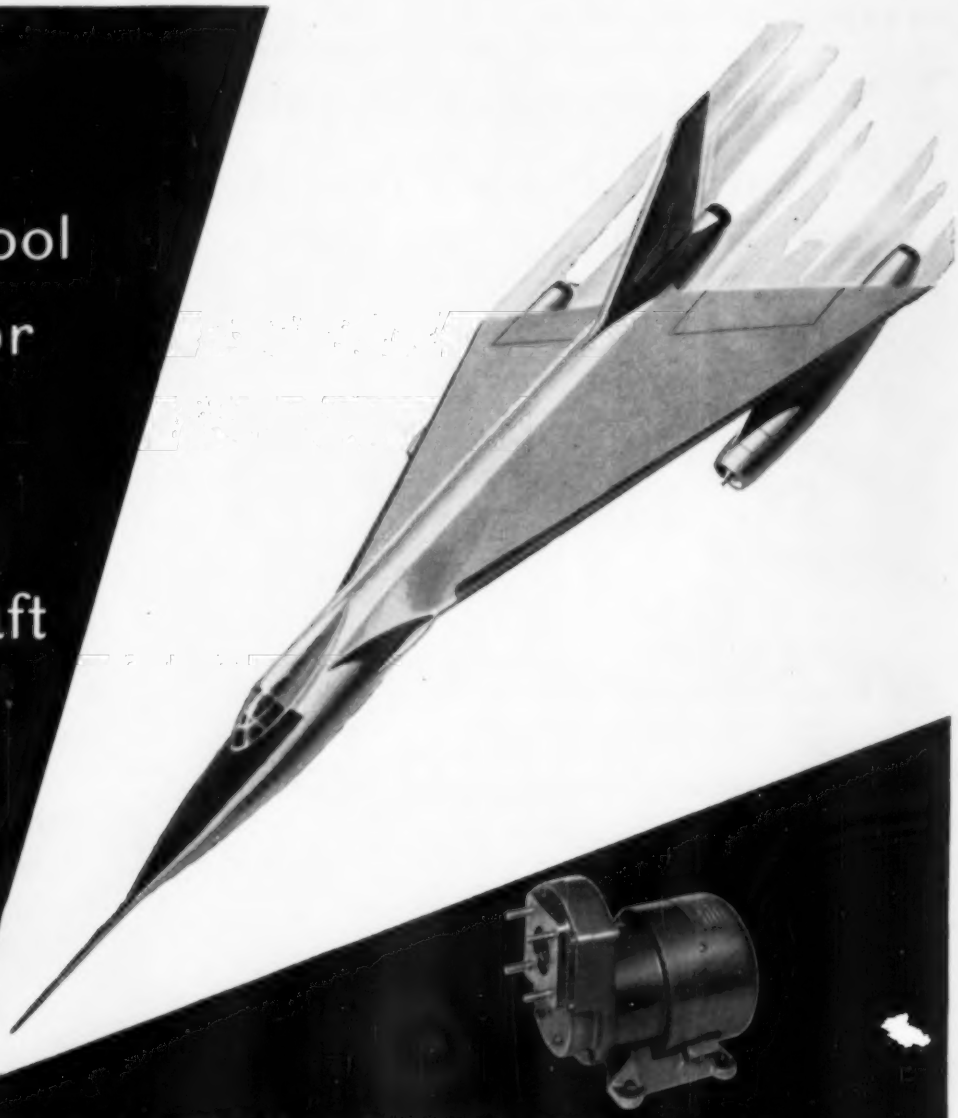

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Result — this Westinghouse motor operates at a maximum horsepower-to-weight ratio regardless of surrounding temperatures.

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AIRCRAFT EQUIPMENT DEPARTMENT, LIMA, OHIO

Center found in the course of the Navarho evaluation that measurements of rho or distance, as determined by carrier phase comparison, were much more precise than measurements of bearing. For this reason the joint evaluation report issued at Rome proposes a rho-rho version of Navarho.

In discussing the results of rho measurement tests, the report states, "This method of measuring distance can easily provide an accuracy of ±3 mi. to 2,000 mi. and beyond when utilizing 100 kw. transmitters."

Project Officer for Navarho, Maj. Clifton L. Nicholson, assistant chief of the Control Laboratory at the Rome Center, told AVIATION WEEK that with further development in airborne components and increased transmitter power the rho-rho version of Navarho is capable of meeting the most stringent requirements of Air Coordinating Committee Document 58/9.1.

A second advantage to Navarho-rho pointed out in the evaluation report is that rho-rho data is readily convertible into rho-theta coordinates for use with dead reckoning and auto-navigator computers. Simplicity of this conversion stems from the fact that, with the length of three sides of a spherical triangle known, solution can be by the law of cosines.

Operational difficulties are anticipated in the possible implementation of either version of Navarho requiring an airborne precision frequency standard.

Currently available crystal standards require long warm-up periods prior to stabilization or must be provided with an uninterrupted source of power. Rome's evaluation report envisages a storage area and power source at each base or airport where Navarho-equipped aircraft will be based to keep the crystal standards in operating order between flights. The frequency standard would be checked and installed in the aircraft immediately prior to a flight. Such crystal frequency standards are presently available.

An alternative to the crystal standard is the so-called atomic clock that is presently under development. (Oct. 22, 1956, p. 103). However, it appears that for the present at least they will be both heavy and expensive.

## Expansions, Changes In Avionics Industry

Infrared Industries, Inc., Needham Heights, Mass., is name of newly formed company which will develop and manufacture infrared sensors and subsystems. New firm is headed by E. Douglas Reddan, president, and Norman C. Anderson, vice president, both formerly with Electronic Corporation of America. New firm's address: 163 Highland Ave.

Other recently announced avionic industry expansions and changes include:

• **Hoffman Laboratories, Inc.**, Los Angeles, formed new Electro-Mechanical department to develop and manufacture servomechanisms, gyros, inertial platforms and other precision electro-mechanical devices. Laurence Mendelsohn has been named vice president in charge of new department to be housed at 2621 South Hill St., near Hoffman's main plant.

• **Electrosolids Corp.**, North Hollywood, Calif., will build 10,000 sq. ft. assembly plant at Canoga Park, Calif.

**Tape Typewriter Aids Datamation**

Electronic punched tape typewriter made by Remington Rand translates typed data into punched tape for subsequent automatic processing or, when fed punched tape prepared by it or other machines, automatically reads and types out the information at 120 words per minute.

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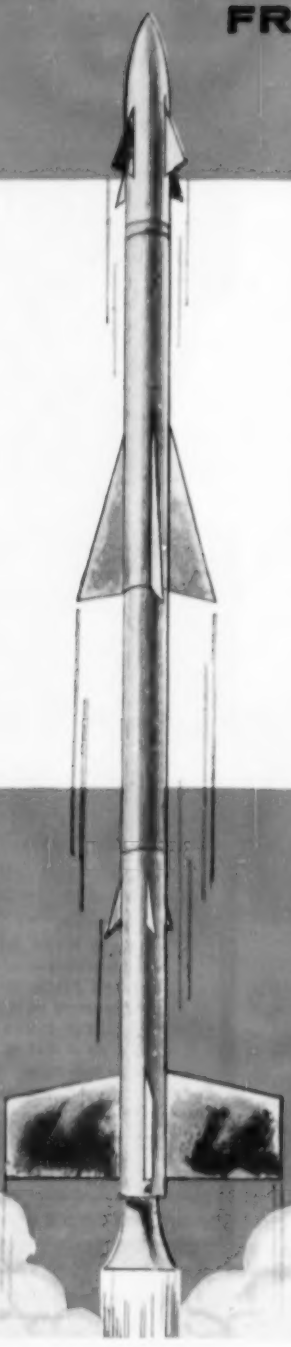

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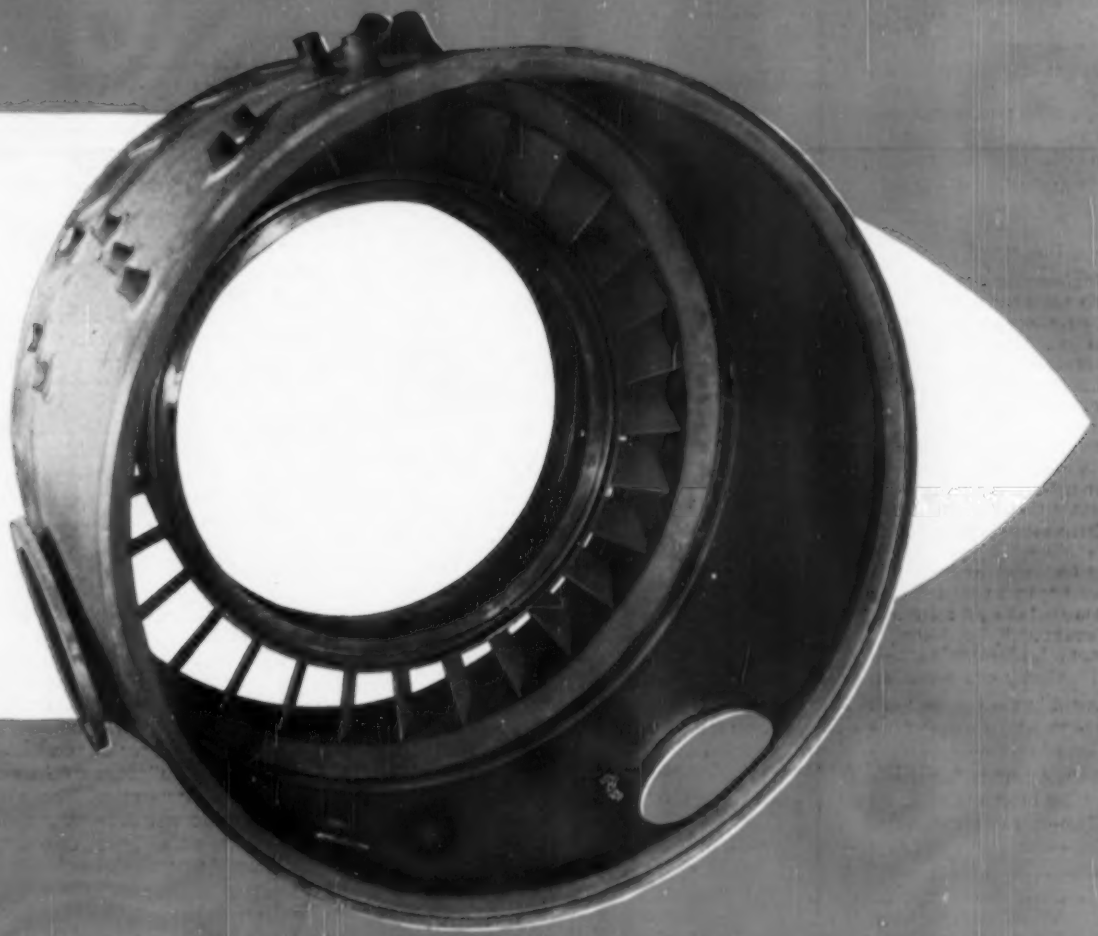

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BINGHAMTON, NEW YORK

## Traveling Wave Tube Offers Weight Saving

**Princeton, N. J.**—Significant weight saving in airborne electronic countermeasures and radar equipment may result from new type traveling tube, developed by Radio Corporation of America. New tube uses electrostatic focusing to eliminate 5 to 30 lb. of external focusing magnet previously required.

Experimental S-band traveling wave tube, developed by Dr. K. N. N. Chang, weighs only 1 lb. complete, compared to about 20 lb. for a comparable tube with magnetic focusing. New technique can be applied to tubes for a wide range of microwave frequencies, Dr. Chang told AVIATION WEEK, it being limited only by mechanical fabrication problems. For extremely high frequencies, the new tube may prove more difficult to manufacture than a conventional design, but at such frequencies magnet weight is relatively low.

RCA achieves electrostatic focusing by using two pairs of spiral windings, one pair surrounding the electron beam (as in conventional designs), the other inside the hollow electron beam. The two pairs in combination provide focusing while the outer pair carries the radio frequency signal being amplified.

Others have constructed traveling wave tubes with electrostatic focusing, AVIATION WEEK was told, but RCA reportedly is the first to use a pair of spiral windings inside the electron beam. RCA's electrostatic focusing technique does not sacrifice any of the desirable characteristics of magnetically focused tubes, and may provide slightly more gain, Dr. Chang said.

Built-in electrostatic focusing eliminates the problem of aligning the tube relative to magnet during installation or field replacement, an important advantage, according to RCA. It also eliminates possibility of magnet becoming misaligned during use as result of shock and vibration.

New tube is moving from laboratory into development stage and RCA does not indicate when pilot quantities might be available.

## FILTER CENTER

▶ **Radar Beacon Tests Soon**—Civil Aeronautics Administration's service evaluation of air traffic control beacon system is scheduled to start within 90 days in New York area. Number of airliners flying into New York area will be equipped with transponders for the evaluation.

▶ **Automation for CF-100**—Avro CF-100s will be equipped with Minneapolis-Honeywell coupler which will enable radar fire control system to directly guide airplane to the target, operating through an M-H autopilot. Command signal limiting provision is included to prevent fire control system from calling for dangerous maneuvers.

▶ **Signed on Dotted Line**—Major contract awards recently announced by several avionics companies include:

- **Epsco, Inc.,** Boston, will build data processing equipment for General Electric's Missile and Ordnance Systems department. Equipment will be used to process missile test data preparatory to computation in a digital computer.
- **Avco-Crosley** reports three new contracts totaling $11.4 million. One, for $6.6 million from Air Materiel Command, is for three improved Volscan traffic control computers. The other two, one for $3.6 million from International Business Machines Corp. and one for $1.2 million from Hazeltine, cover equipment for use in SAGE air defense system.
- **Packard-Bell Electronics Corp.** has received Army contract to develop high-speed digital computer for use at Redstone Arsenal's computation center.
- **Radio Corporation of America** reports $250,000 order from Scandinavian Airlines System for AVQ-10 radars for use in the SAS fleet of DC-7C's.

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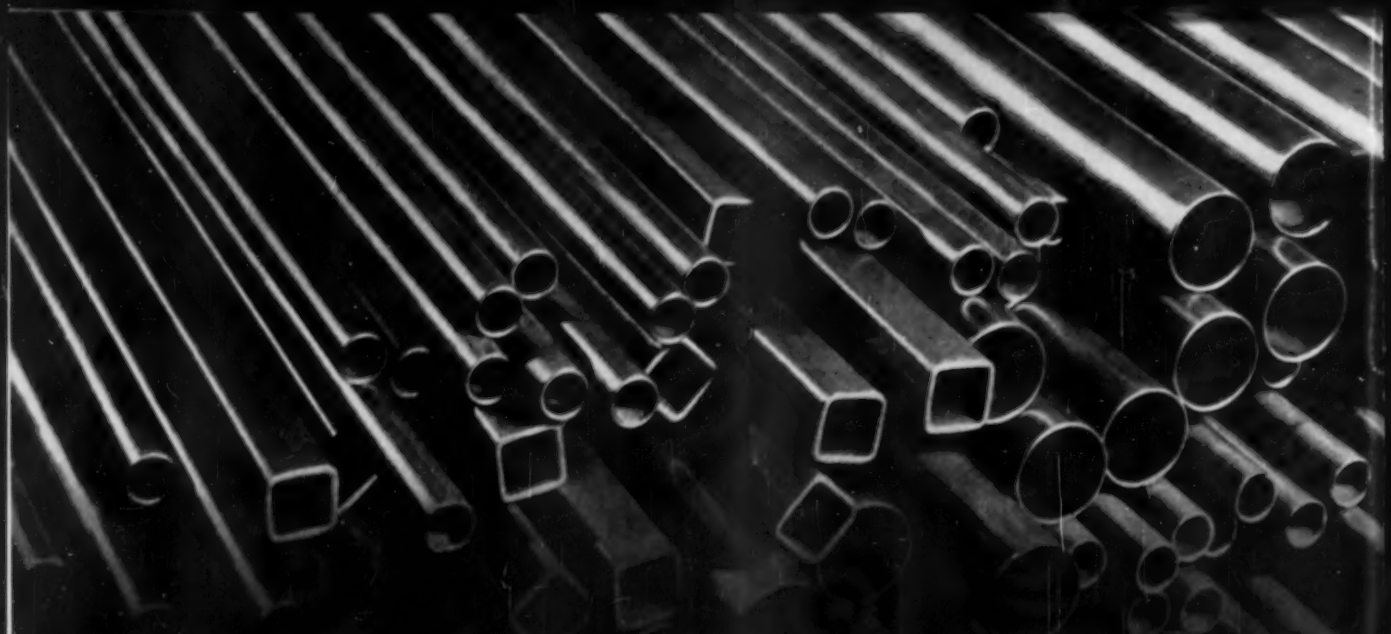
**TECHNICAL OPERATIONS** units for isotope radiography—sources, equipment, containers for Iridium 192 Cobalt 60 and Thulium 170.

Picker x-ray



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*CAB Accident Investigation Report:*

# Single Engine Approach Made Too Fast

At 1504,[1] November 15, 1956, Trans World Airlines Flight 163, as Martin 4-0-4, crashed at McCarran Field, Las Vegas, Nevada. The accident occurred during an attempted single-engine go-around. The captain and hostess and 14 of the 35 passengers received minor injuries. There was no fire; however, the aircraft was damaged beyond repair.

## HISTORY

Trans World Airlines Flight 163 is a regularly scheduled domestic operation between Kansas City, Missouri, and Los Angeles, California, with intermediate stops at Topeka and Wichita, Kansas; Amarillo, Texas; Santa Fe and Albuquerque, New Mexico; and Las Vegas, Nevada. A scheduled crew change is made at Albuquerque.

There, on November 15, 1956, Captain Arthur G. deFabry, First Officer James P. Rapattoni, and Hostess Anne J. Zeman boarded Flight 163 as its crew to complete the remaining segments. The flight was routine to Las Vegas where it landed at 1440.

During the short ground time at Las Vegas the aircraft was serviced and the crew performed routine duties for continuation of the flight to Los Angeles. There was no apparent need for maintenance on the aircraft and none was performed.

An Instrument Flight Rules flight plan was prepared and filed because of instrument weather conditions over the latter portion of the flight segment to Los Angeles. Weather conditions at Las Vegas, however, were clear.

At 1449 Captain deFabry, seated in the captain's position, taxied N 40404 from the Las Vegas terminal to runup position beside runway 7 where the required pre-takeoff checks were accomplished. The aircraft and equipment responded normally. The flight was issued an instrument clearance by Air Route Traffic Control.

At this time, according to the company load manifest, the gross weight of the aircraft was 41,801 pounds, well under the maximum allowable for takeoff, 43,650 pounds. The load was properly distributed with respect to the center of gravity limitations of the aircraft.

### Engine Fails

With Captain deFabry operating the aircraft, Flight 163 took off at 1456. The takeoff was routine and was followed by a climbing left turn to gain altitude and establish a southwesterly course toward Los Angeles. At 1501, when over the northern perimeter of the city, First Officer Rapattoni radioed the Las Vegas tower stating the flight was returning to the airport, engine out.

The Las Vegas tower controllers immediately notified all other traffic to remain clear and alerted emergency equipment. Flight 163 was cleared to land, any runway, and informed that the wind was calm. Captain deFabry elected to use Runway 7 and First Officer Rapattoni notified the tower. Emergency equipment was then dispatched into position on the taxiway parallel to that runway.

N 40404 was soon observed on a wide base leg for Runway 7. As it turned onto the final approach position and altitude of the flight seemed normal. As the aircraft drew closer its extended gear could be seen and its left propeller was clearly visible, stopped and feathered.

As the aircraft passed over the runway threshold its alignment, position, and altitude seemed good; however, to nearly all observers excessive speed was apparent. The aircraft floated a considerable distance down the runway before touching it. It then bounced several times, after which an application of power was heard, obviously in an attempt to go around.

The Martin climbed, veered to the left, and its left wing gradually lowered. It seemed to "struggle" to continue flight and its airspeed decreased visibly. Seconds later the aircraft struck the ground, left wing low, just inside the airport boundary.

Weather conditions at the time of the accident were clear, visibility 65 miles, and the wind was calm. A large cloud of dust, raised by the accident, hung over the scene and gradually lifted nearly vertically in evidence of the calm wind.

## INVESTIGATION

One witness, who was operating an emergency vehicle on the taxiway parallel to Runway 7 when the accident occurred, reached the scene within a few seconds. He said that passengers began to evacuate the aircraft approximately 30 seconds after

[1] All times herein are Pacific standard and based on the 24-hour clock.

**TWA MARTIN** 4-0-4 after settling into the ground during single-engine go-around at McCarran Field, Las Vegas, Nev.

"Bernie" Fenwick, outside Friendship International Airport's Terminal Building. Directly behind him is a Constellation operated by Eastern Airlines, one of Pan-Maryland's airline customers.

# "There's no ceiling on success when you fly with Shell!"

*says G. B. Fenwick, Jr., President of Pan-Maryland Airways. P-M boosted its gallonage fiftyfold in six years as a Shell Aviation Dealer at Friendship International Airport, Baltimore*

It's no wonder Bernie Fenwick is happy Pan-Maryland teamed up with Shell in April 1951. At that time, one truck was more than enough to handle their business. Three months later, thanks to Shell's help, they began making into-plane deliveries to the airlines.

Today, Pan-Maryland has 13 trucks busy fueling and servicing the airlines, private airplanes, jet fighters of the National Guard, police department aircraft, helicopters, military

and government-owned aircraft and dozens of corporate aircraft.

"We've got an extremely diversified operation here," says Bernie. "Pan-Maryland handles everything from Cubs to F4D Navy jets—from Mites to B-52's.

"Consequently, we handle the complete line of Shell Aviation Fuels, including Shell Turbine Fuels for jet planes and commercial turboprop airplanes.

"Shell also provides us with a full line of AeroShell lubricants, fluids and greases to fit our customers' needs. What's more, we get up-to-date technical advice from our Shell representative who's always at our service."

When Bernie talks about the services Pan-Maryland gives its customers, he emphasizes that delays are almost nonexistent. All pilots have schedules to meet and what they want most of all is fast, efficient, on-schedule service.

A "Customer's Service Report" is mailed to every flier who stops at the field. It invites comments and criticism of service, workmanship and courtesy. Replies like "Best service I've ever gotten—anywhere," "Excellent in every way," "Keep up the good work," are received every week from all over the country.

Bernie points out that their CAA Certified Repair Station is going to be finer than ever. A big new hangar will be completed soon and he plans a Class 4 shop there, with service crews qualified to work on every type of plane.

Other plans for the future include branching out into airline ramp service, setting up an aircraft sales department, building more hangars *and boosting gallonage still further.*

"After all," says Bernie Fenwick, "the sky's the limit with Shell."

Private planes get first-class treatment, too. Every civilian pilot who uses the field receives a "Customer's Service Report" which requests suggestions for improving service.

The Boeing 707 jet transport is fueled by Pan-Maryland with Shell fuel at Friendship International Airport after its recent record 3-hour, 48-minute transcontinental flight.

Bernie discusses plans for future expansion with Col. J. Colonna, Airport Director.

**It pays to be a Shell Aviation Dealer**

***—and the Shell office nearest you will be glad to show you why***

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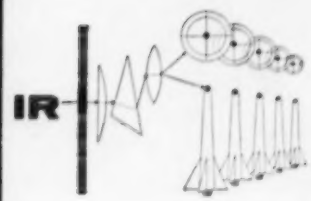


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## Cubana Orders 707s

**Markings of Compania Cubana de Aviacion are drawn on Boeing 707, two of which have been ordered by the airline. Model chosen was 707-120. Aviation Week had reported (April 1, p. 40) that Cubana would order the 707s and also two Bristol Britannias.**

his arrival and that all the occupants were out in less than two minutes.

Nearly all concerned said the evacuation was orderly and that it was carried out under competent direction and supervision of the crew members, using the forward loading door and emergency window exits 4-A, 4-D, and 8-A.

Ground marks showed that the left wing tip of the aircraft made the initial contact with the ground and this was followed closely by the left engine nacelle and aircraft fuselage. The aircraft then slid on its belly in an upright position for 225 feet along a northeast heading. While sliding, the aircraft turned left around its vertical axis so that when it stopped the aircraft was headed northwest. The final resting place was located about 900 feet north of the centerline of Runway 7 measured from a point 200 feet west of the east end of that runway. Airport elevation is 2,171 feet, mean sea level.

### Aircraft Damage

The aircraft received unrepairable damage from the ground impacts and the subsequent sliding forces. The fuselage was nearly separated parallel to the fifth row of passenger seats. Elsewhere it was twisted and buckled. The empennage was relatively undamaged. Both wings of the aircraft were buckled and the right wing was broken chordwise just outboard of its engine nacelle.

The left engine was found turned outboard 40 degrees by forces which bent and broke its engine mounts. The right engine was torn out during initial forces and as the aircraft slid forward on the ground this engine was rolled inward toward the fuselage. It then struck and penetrated the right side of the fuselage floor. This unit was found lodged in the cabin flooring just ahead of passenger seat No. 2.

The main and nose components of the landing gear were found fully retracted. The wing flaps were found in a slightly extended position; however, numerous fractures in the hydraulic lines would have allowed the flaps to move from the position which existed at the instant of impact.

The engines and propellers were removed from the accident scene and shipped under government seal to the company's maintenance facilities at Kansas City. There, under the direction of a Board engine specialist, the components were carefully examined.

The left engine was torn down to determine the reason for its failure. All rocker box covers were removed and the rocker arms checked for clearance. The No. 2 cylinder exhaust valve rocker arm was found to have excessive clearance. Its push rod was then removed and examined. The ball end assembly was found to be loose and the spacer between the push rod and the ball end was broken into several pieces and completely displaced. The end of the push rod was worn, with pieces broken away. The ball end socket was belled out and polished.

Evidence indicated, therefore, that the push rod failure occurred where the ball end is press fitted to the push rod. Crew testimony, in addition to the physical evidence, fully supported the push rod failure.

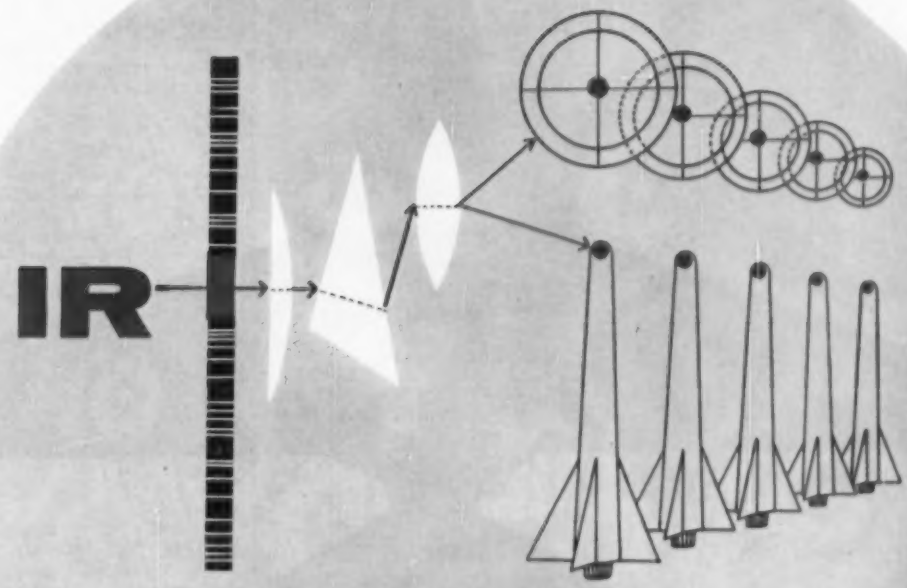
New or reconditioned push rods are installed during engine overhaul. Because the ball ends and rods are purchased separately, whether new or reconditioned, the ball ends are press fitted to the rods as a TWA overhaul operation.

Examination of both propellers and the right engine disclosed no evidence that they were in other than good condition prior to impact. Evidence indicated this engine was capable of delivering its specified power. Further, there was no fault with respect to the antidetonation injection (ADI) system.

Company maintenance records showed the aircraft and its components had been maintained according to company procedures.

There was no record of any inflight push rod failure on TWA Martin aircraft prior to the subject accident.

The investigation of this accident included an examination and bench check of the major components of the hydraulic system. The parts were removed from the aircraft and the work was done, under

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### ENGINEERING BEYOND THE EXPECTED

Mutual interference between IFF and UHF is normally inevitable, even when the units are encased separately and spaced several feet apart. In the AN/ASQ-17 these two units are packaged together, *a fraction of an inch* apart. Yet in official trials *mutual interference was not noticeable or measurable.* This achievement "beyond the expected" resulted from coordinated efforts of Douglas, Chance-Vought and Packard Bell Electronics engineers.

*AN/ASQ-17 will be featured at Booths 609-610,* WESCON, *San Francisco Cow Palace, Aug. 20-23.*

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**TECHNICAL PRODUCTS DIVISION**
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Board supervision, at Kansas City. Test procedures were set up in advance, using as a guide the manufacturer's acceptance tests for each of the units.

This inspection disclosed no significant discrepancies. From examination of the components of the aircraft hydraulic systems it was determined that the hydraulically actuated mechanisms would operate as designed and as directed by cockpit control positioning.

To protect wing and flap structure, the wing flap system of the Martin 4-0-4 incorporates a wing flap unloading valve. According to test flight data published by Trans World Airlines and distributed to its pilots, the unloading valve will not permit a flap extension beyond 35 degrees, throttles fully retarded, unless the airspeed of the aircraft is at 120 knots or less. As airspeed is decreased, the flap extension is progressive until full extension, 45 degrees, is reached at or below 104 knots with throttles fully retarded. The approach flap setting is 24 degrees. This amount of extension can be obtained at 120 knots by selecting the approach flap position.

### Flap System

Therefore, at this airspeed about 10 degrees more flap extension could be obtained by positioning the cockpit flap control in the full flap detent than in the approach position. Examination of the various components of the flap system indicated the system of N 40404 would operate, prior to impact, according to the data described.

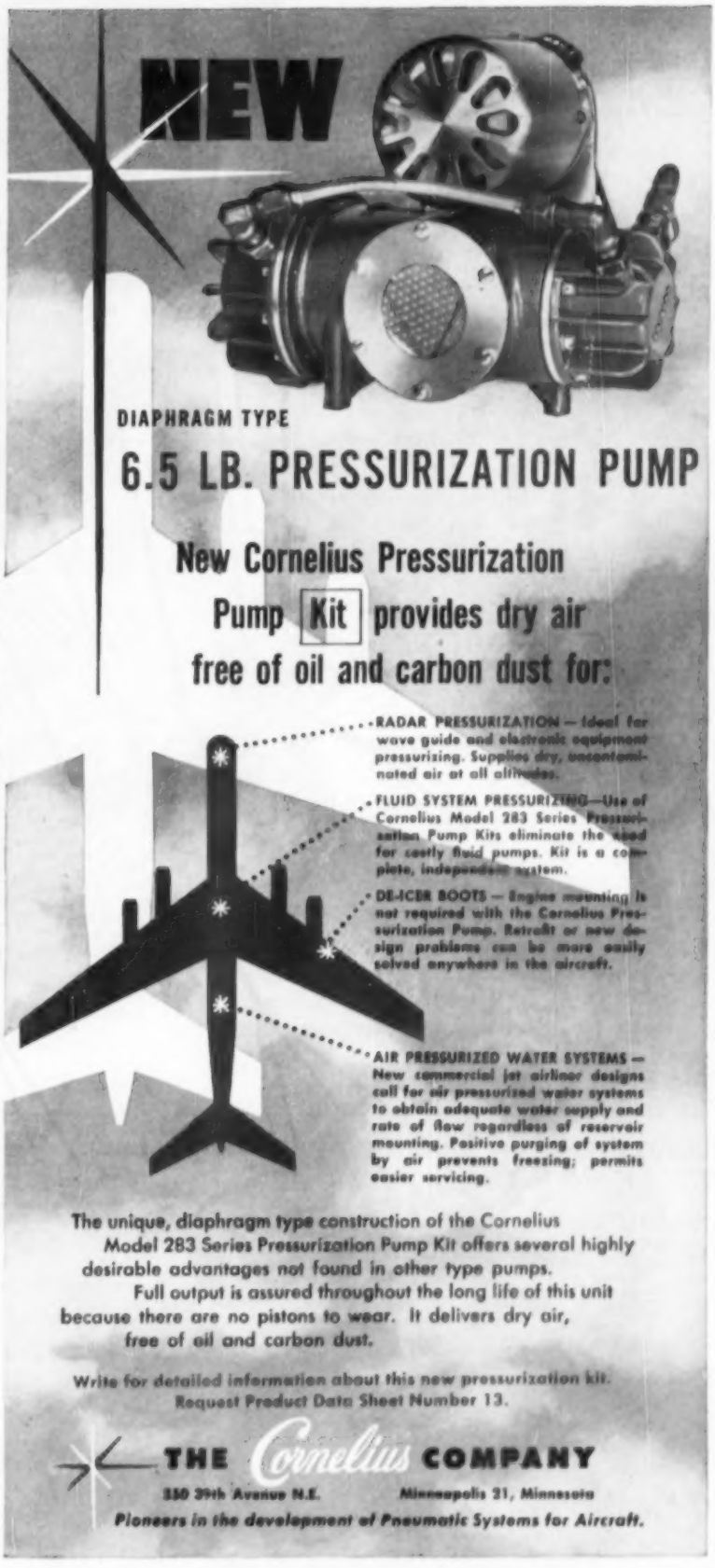
Captain deFabry and First Officer Rapattoni testified that the malfunctioning of the left engine began shortly after takeoff when the flight was climbing over the northern perimeter of Las Vegas. The engine difficulty was in the form of an appreciable power loss, backfiring, and engine roughness. Attempts to correct the trouble were unsuccessful and when heavy and visible vibration began, Captain deFabry, fearing for the safety of the flight, feathered the left propeller taking that engine out of operation.

The feathering was prompt and the propeller rotation stopped. The crew established single-engine operation, notified the McCarran tower of the emergency, and turned toward the airport. The pilots stated the flight entered the traffic pattern on a left base leg and made a long final approach to runway 7. The landing gear was lowered and approach flaps were extended during the final approach. Airspeed was 120-125 knots.

With respect to the runway, the pilots stated the alignment, position, and altitude of the aircraft seemed good.

Captain deFabry said that power was reduced on the right engine and that the flight crossed the threshold at a normal height, or slightly above. At this time the airspeed indicator showed 115-120 knots. The captain testified that this airspeed was excessive and that 95-100 knots would be normal at the threshold. He added that at this time he had not called for full flaps because he thought they would not extend appreciably beyond the approach position until the airspeed had reduced to about 105 knots.

The captain said, however, that when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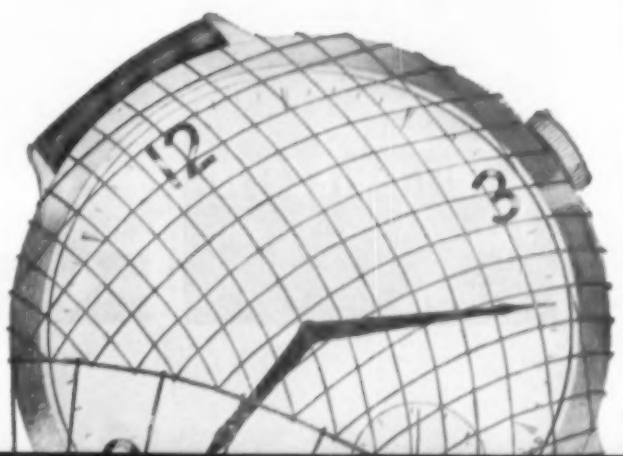
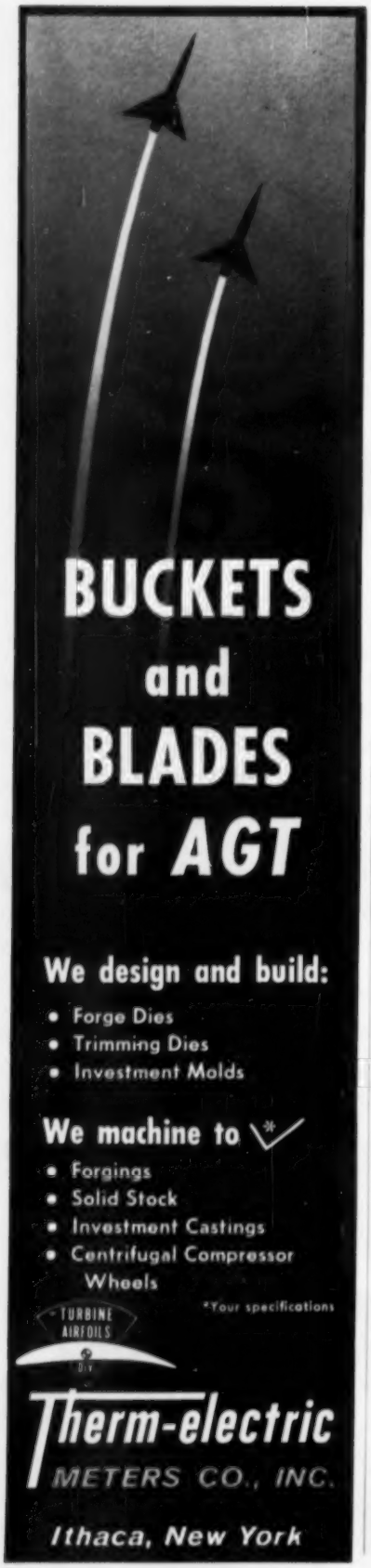
In 1954, America hiked the tariff on jeweled-lever Swiss watch imports by a huge 50%. Since then, further restrictions are being considered. And they could price the Swiss watch right off the wrists of Americans!

But the reciprocal trade between Swiss and Americans has gone on for a long time. It was brought about by men of good will and good business. Surely, today's men of good will and good business will want to prevent a forced landing now.

*Published in recognition of the 106th anniversary of The Treaty of Friendship and Commerce pledged between the people of America and the people of Switzerland*

**THE WATCHMAKERS OF SWITZERLAND**







First Officer Rapattoni asked if he wanted full flaps he answered in the affirmative. First Officer Rapattoni immediately positioned the flap control to the full flap detent. Asked if he thought the captain had overlooked them the first officer stated, "Well, he was pretty busy and that was the reason for my statement. I wanted to be sure, I thought if he didn't know it that I would call it to his attention." He said that full flaps were normally extended prior to the threshold.

### Porpoising

The pilots stated the aircraft did not seem to decelerate and according to most eyewitnesses it floated down the runway a few feet above it. According to tire marks found on the 6,499-foot runway, the initial touchdown occurred 2,749 feet beyond the approach end. Captain deFabry said this touchdown was the result of an attempt to force the aircraft on but that it bounced back into the air. He again attempted to force the aircraft on the runway but again it bounced off. Another attempt followed. Several eyewitnesses described the series of bounces as the porpoising type.

Captain deFabry said that after the last bounce the aircraft was still airborne and its airspeed was 100-105 knots. At this point he was firmly convinced that he should go around and believed the aircraft could do it. He called for takeoff power on the operating engine and up gear. He noted the first officer's prompt compliance. Flaps were retracted to the takeoff position, 12 degrees.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Eyewitnesses positioned close to the runway were unable to estimate accurately the distance consumed by the flight during the series of bounces. Most were occupied watching the aircraft itself rather than this specific detail. Most said they were extremely concerned for the safety of the flight because of the obviously excessive speed. These witnesses, who were aeronautically qualified, stated it was apparent that the pilot was attempting to put the aircraft on the runway but was unsuccessful. Witnesses said that when power was applied the aircraft was then in the air a few feet above the runway surface.

The pilots said that as the flaps raised the aircraft settled and airspeed decreased. The aircraft then immediately veered to the left and its left wing lowered. Observing a house ahead and convinced ground contact was imminent, Captain deFabry pulled off the power of the operating engine and partially leveled the airplane before it struck the ground.

Captain deFabry testified that at the time he decided to discontinue the landing and execute the go-around he was firmly convinced the performance of the Martin 4-0-4 on single-engine would enable him to do so. He stated he believed that such go-around was possible provided the airspeed of the aircraft was appreciably above minimum control speed. He stated that the airspeed, when he initiated the go-around, was 100-105 knots and the minimum control speed of the aircraft in the existing configuration was 91 knots.

The captain further stated that his impression was obviously in error because as the flaps retracted it was necessary to raise the nose to prevent settling into the ground, and airspeed was sacrificed to the extent that continued flight became impossible.

### TWA Training

The captain was questioned about his training with respect to the Martin 404 single-engine performance capabilities. He said that prior to the accident his training included familiarization with various single-engine situations; however, this training did not stress single-engine balked landing or go-around with various aircraft configurations and speeds.

Captain deFabry added that subsequent to the accident he had received a refresher training course which included the Martin 4-0-4 single-engine performance capability in the balked landing situation. The captain indicated that from this he learned that the performance he had expected at the time of the accident was beyond the performance capability of the aircraft.

Training personnel at Kansas City, the principal training center for Trans World Airlines, stated that flight tests simulating the configuration of the Martin 4-0-4 in the accident showed it was necessary to sacrifice about 300 feet of altitude while retracting the flaps to the takeoff position. They stated that on single-engine the flap retraction is necessary in order to allow the aircraft to accelerate. It was stated that following the accident a demonstration of this loss of altitude was given to key operations pilot personnel for dissemination to line captains and the demonstration was added to the company training program.

Further, it is stressed during training that when full flaps are extended at an

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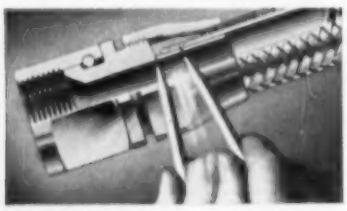

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altitude below 300 feet during a single-engine approach the aircraft is committed to a landing. Training personnel said that although a balked landing procedure was in preparation it had not as yet been made a part of the Trans World Flight Operations Manual.

A company instructor-pilot testified that perhaps the company pilot training had not stressed the single-engine balked landing situation enough prior to the Las Vegas accident. He added that this was probably because the program intended to teach the pilots to make the single-engine approach and landing without overshooting.

He stated this proficiency and ability was expected of a line captain and that in all of the transitions he had given in the Martin 4-0-4 over a period of several years he had never seen an overshoot on a simulated single-engine.

## ANALYSIS

Examination of the No. 2 cylinder exhaust valve push rod showed conclusively that the failure of this rod was the cause of the left engine failure which occurred shortly after takeoff. The examination further showed the failure occurred where the ball end is press fitted to the rod and that the failure was most likely the result of an improper fit made by the Trans World overhaul department.

This failure caused the exhaust valve to remain closed, thereby trapping exhaust gases under pressure which would normally be dissipated through the exhaust port. Therefore, when the intake valve opened these exhaust gases entered the induction system of the engine causing loss of power, backfiring, and engine roughness.

The Board is of the opinion that these conditions would be of such severity that the pilots, as in this instance, would be expected to take the engine out of operation by feathering its propeller. It is recognized that thereafter the pilots operated the aircraft under the stress and demands of an emergency situation. Under this situation the aircraft was handled properly during the downwind leg and until the flight

## SAS Signs for Caravelles

**Scandinavian Airlines System president Henning Throne-Holst (seated, center) and Sud Aviation president Georges Hereil (seated, right) sign contract for SAS Caravelles. The Scandinavian carrier has ordered 6 of the French twin-jet airliners from Sud Aviation, optioned 19 more. Delivery of initial order is expected in 1959.**


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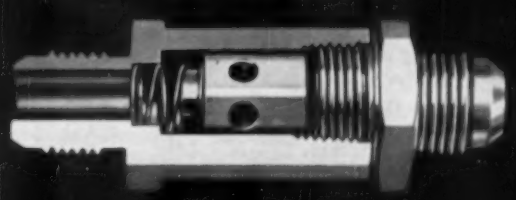

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was positioned on the final approach for landing on Runway 7.

Captain deFabry stated that on the final approach the airspeed was about 120 knots. It is not unusual to maintain a higher than normal approach speed under such conditions. However, this speed must be dissipated at a point when the landing is assured and in time to preclude overshooting. The Board believes Captain deFabry did not properly judge this position. As a result he continued with excessive speed beyond a reasonable position for a safe landing. Contributing to his misjudgment Captain deFabry erroneously believed that with 115-120 knots he could not get additional flaps beyond the approach extension.

Although only about 10 degrees more extension could have been obtained, this difference and its cumulative effect may well have been the difference between the overshoot and a safe landing. Notwithstanding the testimony of Captain deFabry to the contrary, the Board does not discount the possibility that he forgot to call for the full flap position until First Officer Rapattoni reminded him.

Following a series of attempts to force the aircraft on the runway, Captain deFabry believed he would be unable to stop the aircraft in the remaining runway and decided to go around. Because the distance consumed during the bounces is unknown, the Board is unable to determine whether or not the aircraft could have been stopped and considers such a finding speculative.

When Captain deFabry decided to go around he believed the performance of the Martin 4-0-4 on single-engine would enable him to do so. He thought that 10-15 knots above the minimum control airspeed was sufficient although the aircraft was on one engine, it was in a decelerating condition, and the landing gear and approximately 45 degrees of flaps were extended. All of these conditions existed with no altitude to sacrifice. Based on these factors, the Board is of the opinion that the captain's belief was unreasonable.

The Board concludes that the training program of the company with respect to the single-engine balked landing situation was inadequate prior to the accident. This was reflected in the captain's decision and the Board believes this was in a substantial degree responsible for the decision. It is felt that the type of situation which confronted Captain deFabry should have been foreseen by the company and the performance capabilities of the aircraft in such a situation fully covered as a training subject.

The importance of training in this potential accident cause area is reflected by the Board's air carrier statistical data. This shows there have been nine accidents since 1946 involving an engine out or engine malfunction during which the pilot attempted to go around after an overshoot. This data also reflects 80 accidents during the same period in which overshoot was a principal causal factor.

The modifications and additions to the training program subsequent to the accident appear to be adequate corrections to the previously inadequate situation.

## FINDINGS

On the basis of all available evidence the Board finds that:

1. The company, the aircraft, and the flight crew were currently certificated.

2. The flight was properly dispatched from Las Vegas where clear weather and calm wind conditions existed.

3. The prior segments of the flight, the pretakeoff checks, and the takeoff at Las Vegas were normal.

4. Shortly after takeoff the left engine No. 2 cylinder exhaust valve push rod failed causing backfiring, loss of power, and engine roughness; these conditions necessitated taking the engine out of operation by feathering its propeller.

5. Emergency single-engine operation was established, the McCarran tower was notified, and the flight returned to the airport to land.

6. The base leg and final approach to Runway 7 were normal with respect to alignment, position, and altitude.

7. The flight crossed the threshold with excessive airspeed and floated 2,749 feet before touching the runway.

8. A series of bounces occurred as unsuccessful attempts were made by Captain deFabry to force the aircraft on the runway.

9. Believing the aircraft could successfully go around at the speed and in the configuration which existed the captain attempted unsuccessfully to do so.

10. Prior to the accident company pilot training with respect to single-engine performance of the Martin 4-0-4 in the balked landing situation was inadequate.

11. Examination showed there was no malfunction of the right engine, landing


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The Board determines that the probable cause of this accident was that during an emergency situation the captain failed to reduce speed during the latter portion of a single-engine approach; this excessive speed resulted in an overshoot and an attempted go-around which was beyond the performance capability of the aircraft under existing conditions.

By the Civil Aeronautics Board:

James R. Durfee
Chan Gurney
Harmar D. Denny
G. Joseph Minetti

(Member Louis J. Hector did not take part in the adoption of this report.)

## SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident at approximately 1600, November 15, 1956. An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Depositions were taken at Las Vegas, Nevada, on January 17, 1957; Santa Monica, California, on January 21, 1957; and Kansas City, Missouri, on January 23, 1957.

Trans World Airlines, Inc., a Delaware corporation, is a scheduled air carrier with its principal offices at Kansas City, Missouri. It possesses a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration. These certificates authorize the carrier to transport by air persons, property, and mail over various routes, including the route involved.

Captain Arthur G. deFabry, age 40, held a currently effective airman certificate with airline transport rating and an appropriate rating for the Martin 4-0-4. Captain deFabry was employed by TWA April 20, 1943. He had a total of 9,431:54 flying hours, of which 639 were in the type equipment involved. His last physical examination was on September 24, 1956. His last Martin landing renewal check was on October 16, 1956.

First Officer James P. Rapattoni, age 33, held a currently effective airman certificate with commercial rating. He was employed by TWA on May 26, 1947. He had a total of 9,926:40 flying hours, of which 105:32 were in the type equipment involved. His last physical examination was on October 30, 1956. His last Martin landing renewal check was on October 5, 1956.

Hostess Anne J. Zeman was employed by the company August 23, 1956. She graduated from hostess training on September 25, 1956. Her last actual emergency evacuation practice was on September 21, 1956.

N 40404, a Martin 4-04, manufacturer's serial number 14104, was manufactured in 1951. It had a total of 10,451:55 hours, of which 1,087:02 had been since last base overhaul. It had accumulated 76:24 hours since its last No. 8 inspection. The last station service and line maintenance check was accomplished November 15, 1956, at Kansas City, Missouri.

The aircraft was equipped with Pratt and Whitney R2800CB-16 engines and Hamilton Standard propellers, model 43E60-9. The aircraft was currently certificated by the Civil Aeronautics Administration.

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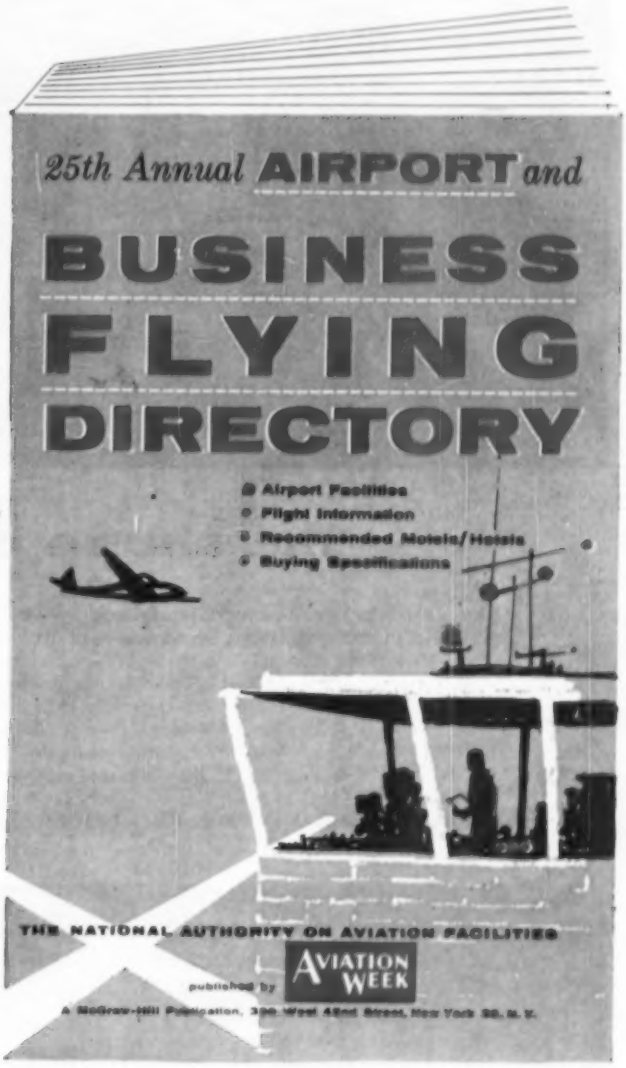


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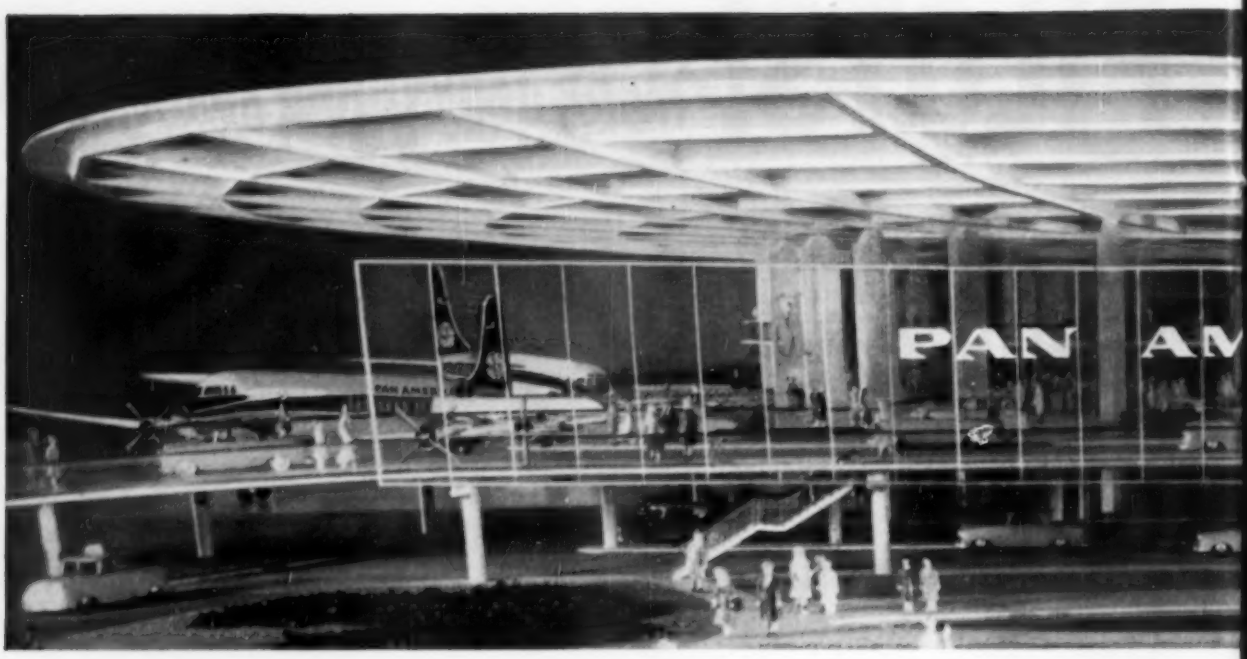


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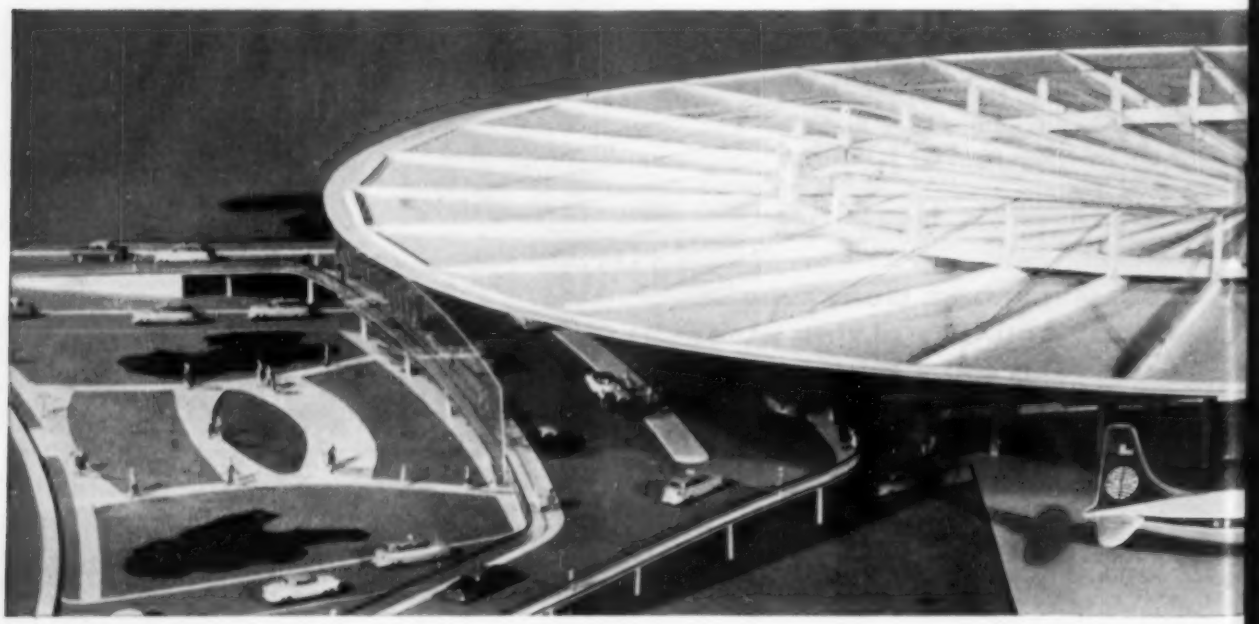

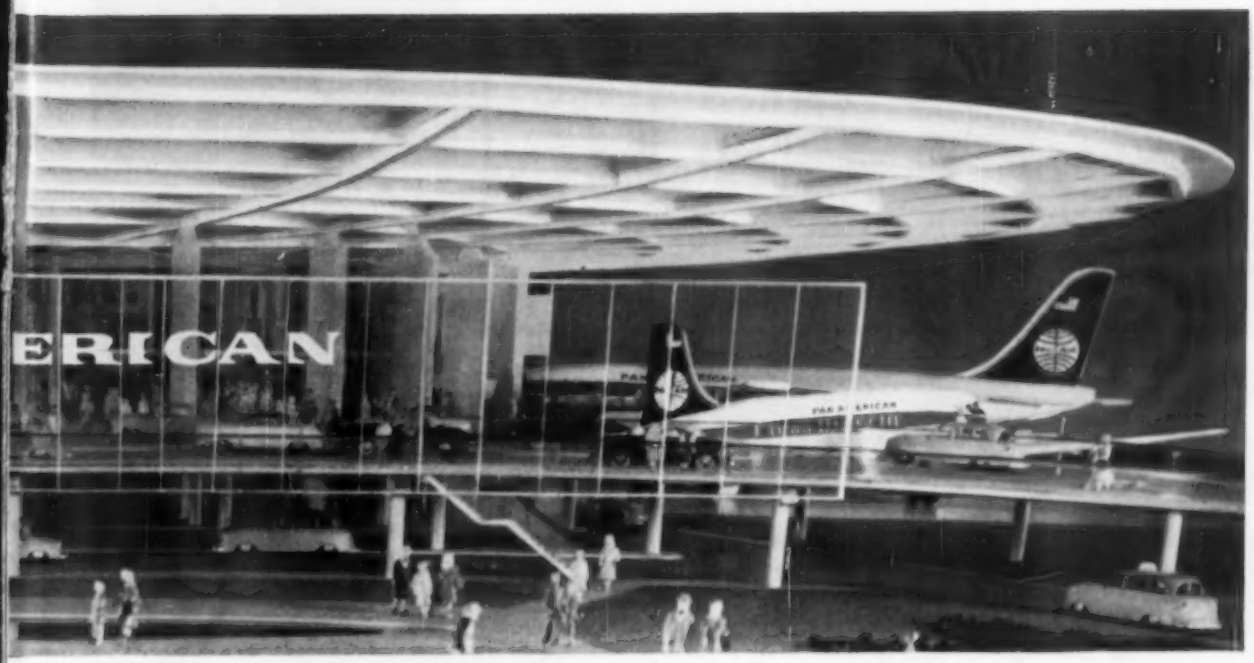


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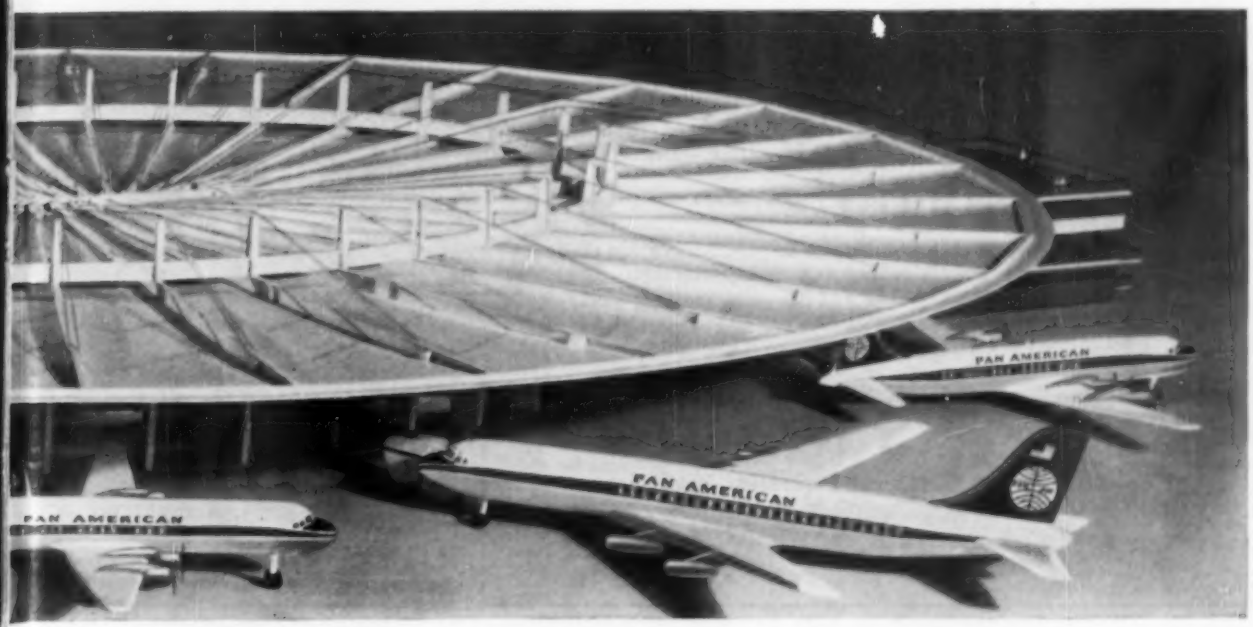

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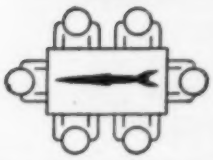

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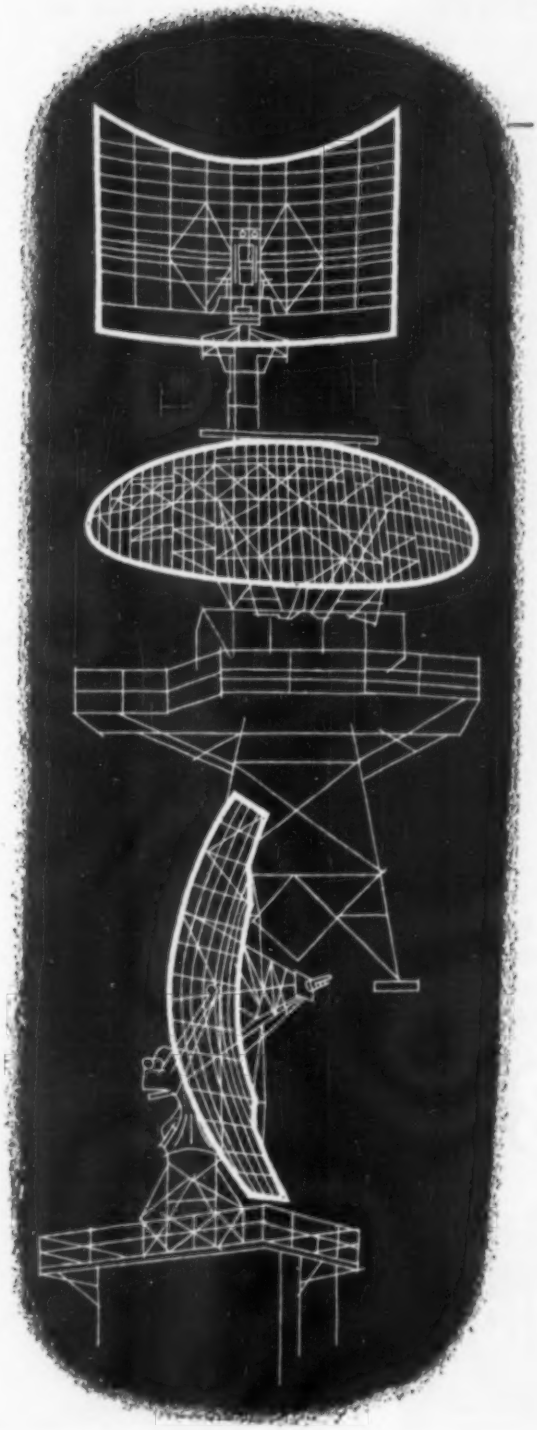

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# LETTERS

## Industry Perspective

As one frequently befuddled citizen of these United States, I'd like to say thank you for your editorial "Where Do We Stand?" in your issue of July 1. It is about the most useful piece I have seen in terms of providing the perspective on the State, and the perspective state of our airpower. I hope AVIATION WEEK sends such editorials as that to editorial writers across the country.

WILLIS PLAYER
Vice President,
Public Relations,
Air Transport Association of America
Washington, D. C.

## 'Excellent Report'

I have just read your excellent report on the shift to hydraulic constant speed drives for the B-52 (AW June 24, p. 81). Of course, we are particularly grateful for your inclusion of Vickers as a supplier of constant speed drives.

It's reporting jobs such as this one that keeps AVIATION WEEK on my "must for reading list" if I am to keep up with what is going on in this fast moving industry.

My thanks again to the editorial staff for the fine weekly job you do, and the very worthwhile help you have given us in the past.

B. W. BADENOCH
General Manager
Vickers, Inc.
Detroit, Mich.

## GE's Reaction

This is just to comment on the article by Bob Cushman in the June 24 issue of AVIATION WEEK, "Air Force Will Switch Drives in B-52" (p. 81).

We feel that AVIATION WEEK has done an excellent job in reporting the complex situation involved in the B-52 decision. We appreciate the difficulty of interpreting the technical aspects, emotional background, claims and counter-claims which are the natural accompaniment of such a move and believe that Bob shows his astuteness as a reporter in the clear overall picture he has given.

PAUL SCHRATTER
Manager, Product Information
Aircraft Accessory Turbine Dept.
General Electric Co.
Lynn, Mass.

## Chinese Sabres

I wish to join you in "Salute to the Sabre" (AW July 15). It was a fine article except that the only air force other than the USAF which used this airplane in combat versus Communists was not mentioned.

The (Nationalists) Chinese Air Force operated sizable number of Sabre Jets at a comparatively later date but was able to render good account of both plane and pilot after a short period of training.

This pilot, and the many others in his unit, flew 600 mi. into enemy territory amid swarms of MiGs and their kind. Our confidence in the aircraft might have carried us a bit too far but the planes brought us back.

As to the Chinese Communist pilots, we feel genuinely sorry for them. As far as Korea was concerned, most of the Chinese Communist pilots were trained out of ex-soldiers.

Education (bourgeoisie style) was apparently a threat to the Communists.

"May old alliance never be forgot . . ."

KOSIN C. SHAH, Lt. Col.
Sub-Division for Air Force
Chinese Government Procurement
& Services Mission
Washington, D. C.

***Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address Letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.***

## Italian Team

I have just received my June 17 issue of AVIATION WEEK and was delighted to see your cover picture of the Italian Acrobatic Team landing in tight formation—also the fine pictures and comments on p. 50.

We of the Air Force Section of MAAG Italy have felt for some time that the Italian Acrobatic Teams were among the best. Now we can feel that we were not too prejudiced.

COLONEL MARION J. AKERS, USAF
Chief
United States Air Force Section
Military Assistance Advisory Group
Embassy of the United States of America
A. P. O. 794
New York, N. Y.

## Subsonic First

I am deeply touched by the concern of AVIATION WEEK and some of its readers over the subject of supersonic wind tunnels (AW July 8, p. 154). Having executed the design of supersonic, transonic, as well as (the apparently-overlooked-in-the-rush) subsonic wind tunnels, their interest is appreciated.

However, this letter is not merely to extol the virtues of the supersonic, but to point out that every aircraft, every missile, every instrument, and every pilot that attains and exceeds the velocity of sound must, both before and after the super-acoustic joy ride, pass through the "forgotten regime" known as the subsonic.

Harking back to the subsonic era, one may note that to this day new subsonic wind tunnels are being constructed, not only by institutions of higher learning but by various airframe and missile manufacturers who find that their subsonic headaches have not all been anticipated in the prolific files of the NACA. Add to this group a growing realization by instrumentation manufacturers that aerodynamic problems are involved in subsonic navigation, control, and fire control subsystem hardware; as well as R & D needs for BLC information, safe takeoff and landing data, VTO and vertical landing problems, stiffer environmental reliability test requirements, parachute and pod safety problems, launching dynamics, to mention but a few of the left-overs of a previous decade (which may be with us indefinitely), and we see that some honorable mention is due the venerable subsonic test tunnel.

To paraphrase the plaint of a previous contributor to your column "apparently only our customers know that we" design and construct wind tunnels.

H. M. SPIVACK,
President,
West Coast Research Corp.
Los Angeles, Calif.

## We Did

Wow! I'll bet you catch it this time!

Re AVIATION WEEK, June 17, p. 33, and July 8, p. 154:

The airplane depicted is one known now as a P4Y-2 which formerly was known as a PB4Y-2 Privateer.

JOHN B. PARADIS
Assistant Head,
Patrol-Trainer Branch,
Flight Test Division
(And a former PB4Y-2 pilot!)
Naval Air Test Center
Patuxent River, Md.

## . . . But He's Content

In reply to "Disgusted Engineer" about his very tough time in trying to get ahead legit (AW July 8, p. 154), I should like to give him the results of a little survey we took in our own office.

The very first conclusion from this survey was that his figures are way off. That 60% for 'bull sessions' doesn't do us any justice at all—it's at least 70% here, and then I think we're being conservative! That 5% for the opposite sex is also most certainly an underestimate. Our survey shows that the engineers in our office spend at least 25% of their time either ogling or characterizing the girls. That 5% for shooting rubber bands is about right, but then that takes all the time we have during the working hours, which forces us all to come in to work in the evenings to get our work done.

Now, since we all have to come in at night like this, we just don't have any individuals working "on nights when the boss is going to be there" because we're *all* there!!

I work long hours, but I'm certainly a—

CONTENTED ENGINEER
Akron, Ohio

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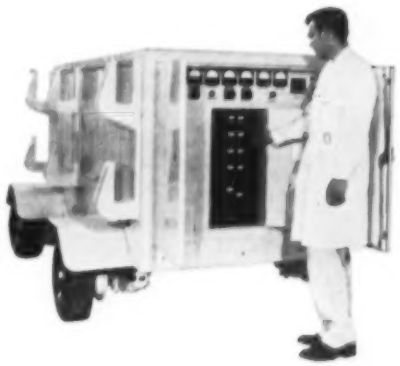

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